HAEMONETICS®

MCS®+

Service Manual
For Use with the LN 9000

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Braintree, MA 02184

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Scope

This manual is intended for qualified technicians who seek detailed information on the operation, troubleshooting, and repair of the Haemonetics MCS®+ LN 9000. Operators and others who require detailed operating instructions and basic maintenance information should refer to the *MCS+ LN 9000 Operator and Maintenance Manual*.

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Appendix B, MCS+ System Schematics

Chapter 1
MCS+ Introduction

Using state of the art computer and blood processing technology, the Haemonetics MCS+ collects blood components including platelets and plasma. Therapeutic Plasma Exchange and Component Therapy Protocols are also available on the MCS+.

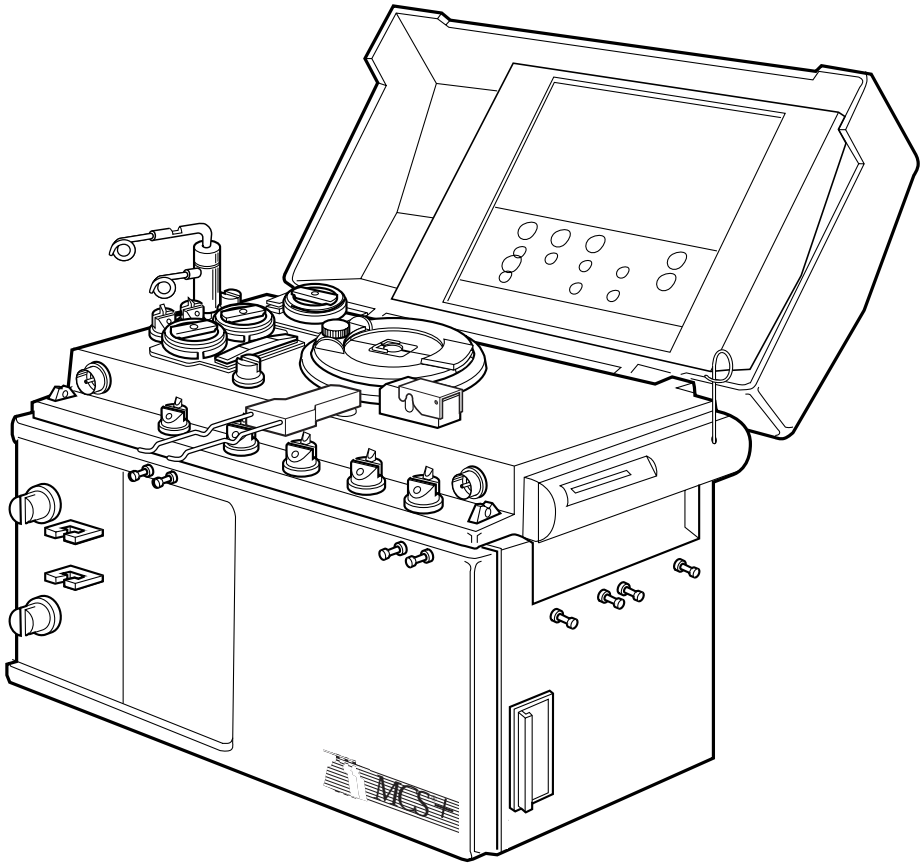


Figure 1-1, MCS+ LN 9000 seven valve machine

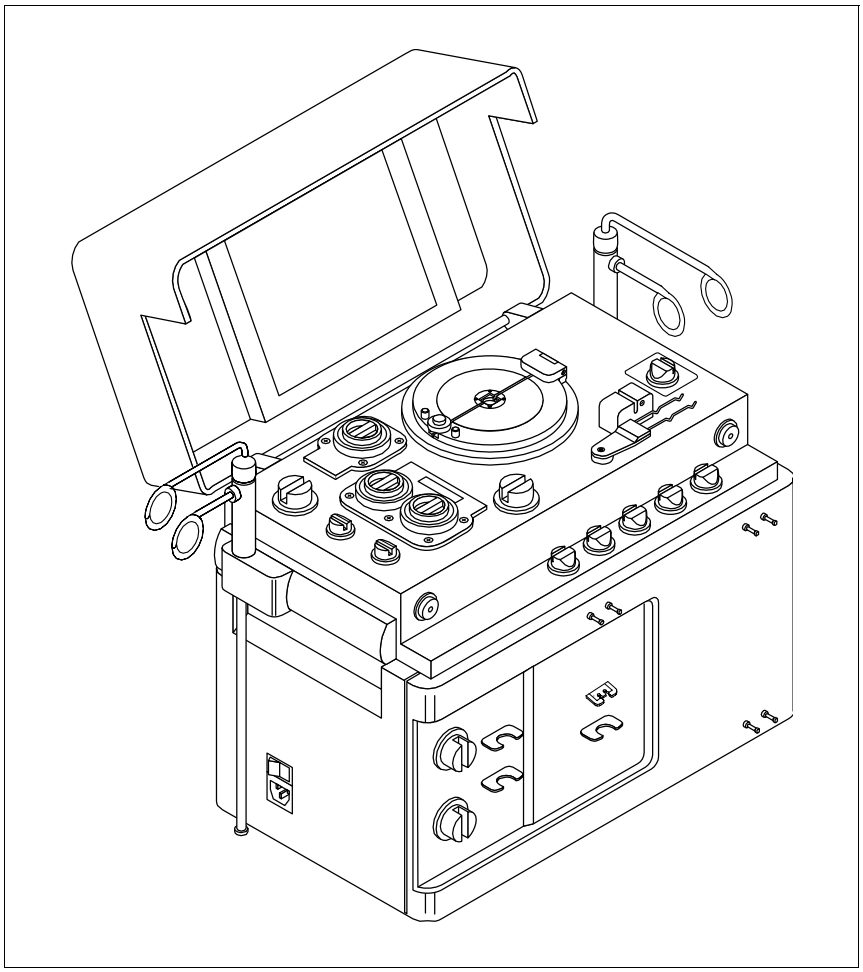


Figure 3-2, The MCS+ device eight valve machine

Physical Characteristics

The MCS+ provides the following attributes:

- Transportability. The MCS+ is compact and weighs less than 25 kg (55 lb.) making it well-balanced and easy to carry. The transport case can also be used as a stand. The MCS+ meets the requirements for impact and durability for a portable device.
- Easy top loading pinch valves are color-coded with lights to indicate when open.
- The donor lights, located on the cover, front panel, and handles are easily read.
- Three pumps and seven valves provide quiet operation. The pumps are self-loading with disposable tubing holders.
- Drip monitor for monitoring anticoagulant flow.
- Easy to clean and spill proof. The dust filters are easily exchanged (no screws required).
- Provides an accessible RS-232 port on the back panel, as well as a cord wrap.
- Meets International Standards (UL, TUV).

Operational Characteristics

The MCS+ provides the following operational characteristics:

- A third pump, referred to as the White Pump, enables the MCS+ to maintain a more consistent “critical flow,” enabling efficient platelet collection.
- A large, interactive user interface provides ample feedback and on-line help.
- The “HaemoCalculator” function allows the operator to input donor information to optimize the blood component collection process.
- The “HaemoUpdate” function gives the operator a full running update of all procedure details at any time.
- A removable Protocol Card makes it possible to change or upgrade the collection protocols performed by the MCS+ without opening the cabinet and without the help of a service technician.

Function and Safety Structure

A single microprocessor (µP) has control tasks for the function of the system. The machine function includes support for the Protocol operation.

- A removable pre-programmed Smart Card provides protocol-specific information to the UP. A bar code, affixed to the disposable, determines the safety system verification of the disposable. The Operator must confirm the protocol and the disposable type before starting the procedure.
- The safety system uses an independent hardware safety printed circuit board (PCB) known as the Advanced Safety PCB, which is implemented in two channels for advanced safety.
- The UP performs a self test during T1-test (RAM, ROM, Registers and Safety Input/Output) to verify its functionality. The Advanced Safety PCB is tested by the UP before every procedure to confirm that it can fulfill its tasks in the correct manner.
- The UP sends test codes to the Advanced Safety PCB, which both read the same input signals including the disposable safety label. When any fault is detected, the Advanced Safety PCB presents an error message to the UP.
- Both the UP and the Advanced Safety PCB are able to stop the function of the motor and valves, and initiate alarms to let the operator know that an illegal equipment state exists.

Protocol Choices

The MCS+ provides the option to choose from a variety of component collection and therapeutic protocols. Upon power-up, the MCS+ display indicates which protocols are present on the installed Protocol Card.

Several of these protocols may be used with saline compensation. Listed below are the protocols available on the MCS+.

Table 1-1: Protocols available on the MCS+

Seven valve machine	*Eight valve machine*
Single Donor Platelets (SDP)	Platelet Poor Plasma & Fresh Frozen Plasma (PPP & FFP)
Platelets and Plasma (PLP)	Leuko-Depleted Platelets (LDP)
Single Donor Platelets with Saline (SDPS)	Red Blood Cell Plasma (RBCP+)
Platelets and Plasma with Saline (PLPS)	Peripheral Blood Stem Cells (PBSC)
Therapeutic Plasma Exchange	Therapeutic Plasma Exchange (TPE)
Component Therapy	Leukodepleted Platelet & Red Blood Cell (LDPRBC)
	Single Donor Red Cell, Therapeutic & Autologous Erythropheresis (SDR&TAE)

Typical Collection Sequence

During a procedure, an appropriate ratio of anticoagulant is automatically mixed with the donor/patient's blood as it flows through the collection disposable tubing. The anticoagulated whole blood is then separated into components within a spinning centrifugal chamber (the bowl).

When the bowl is full, the separated components begin to exit sequentially, with the least dense components (which are closest to the core) exiting the bowl first. As the components exit the bowl they are diverted to one or more collection bags. Once the desired components are collected, the bowl stops spinning and the components left in the bowl are pumped out and returned to the donor/patient.

Chapter 2
Equipment Description

This chapter describes the disposable sets and provides descriptions and circuit information for the MCS+ hardware components.

The MCS+ is a combination of three subsystems: a disposable set, an electromechanical device and computer software. The three subsystems are integrated to perform the component collection function. The subsystems are described in detail in the following sections.

All components of the MCS+ should be installed in a way to ensure optimal use and to provide easy access for the operator to perform necessary cleaning, sterilization and disinfection procedures.

Disposable Set Descriptions

The processing of all fluids occurs within the disposable. The electromechanical device controls the rotation of the disposable bowl and the flow of fluid to and from the disposable bowl.

Bacterial AC Filter

The 0.22µ filter is attached to the anticoagulant line of the disposable sets. This filter prevents contaminants (that may be present as a result of manual connection of the anticoagulant to the disposable) from passing into the collection disposable. The flow of the anticoagulant is not restricted.

This filter allows the attachment of anticoagulant solution using a spike while still maintaining a functionally closed system. It does not affect the extended expiration date of the platelet product.

Biohazard Waste Bag

This bag is attached to the drain port on the centrifuge well. Should there be a fluid spill in the centrifuge well, this biohazard waste bag captures the fluid as it drains from the port.

Note: **A biohazard waste bag should be attached to the centrifuge drain at all times during machine operation. The bag must hang freely without tubing occlusions. The biohazard waste bags provided are not intended for the collection and storage of transfusable products. Haemonetics recommends handling and disposal of these bags, once contaminated, pursuant to those policies and procedures dictated by the medical facility's Exposure Control Plan, as legally required by the OSHA Bloodborne Pathogen Standard.**

Donor Pressure Monitor Luer Connector

The Donor Pressure Monitor (DPM) Luer Connector contains a 0.22µ filter to prevent the infiltration of potential contaminants into the disposable. It is intended to be coupled with the receptor on the DPM to assist in the monitoring of the donor blood flow.

Note: **If the DPM luer connector becomes wet at any time during the collection, there is a potential for infiltration of blood to the donor. For this reason, the operator should monitor the venipuncture site during the return cycle.**

The DPM and SPM luer connectors do not have protective caps. Since these luer connectors contain bacteriostatic filters, the disposable remains a closed system.

Extended Storage Platelet Bags

These bags are designed to permit storage of platelet concentrate up to and through five days after collection. The bags permit proper transfer of gases to maintain suitable storage conditions for platelets for an extended period of time.

The extended storage bag used in both the Platelet and Platelet/Plasma Protocols has a 1000 ml capacity. This volume assures a sufficient surface area for the transfer of gases for the expected number of platelets collected during the Platelet and Platelet/Plasma Protocols.

Injection Port

Note: **The diaphragm injection site on the platelet and therapeutic disposable sets is intended only for emergency situations requiring the administration of fluids or drugs. It is not intended for routine use. If the injection site is used before removing the platelet concentrate from the collection set, the storage life of the platelet product is reduced to 24 hours.**

Leukocyte Reduction Filter

This filter is part of certain platelet disposables (LN 994CF and LN 994F) to allow filtration of the platelet product for reduction of white blood cells prior to storage.

Preattached, Ultra-thin-wall Needle

This needle ensures no contamination of the collection disposable that could occur from external sources during the brief period in which a separate needle and the needle adapter are exposed prior to connection.

Note: **If at any time during collection the needle is disconnected from the harness, the storage life of the platelet product is reduced to 24 hours.**

Presample Pouch

This pouch allows the collection of donor blood samples without a separate venipuncture. It is recommended that the tubing be hermetically sealed before sampling from the pouch and may not be reopened to the collection disposable without compromising the extended storage dating.

Note: **Disposable sets for protocols that do not require extended storage dating may include other elements and may not include some of the elements listed above.**

System Pressure Monitor Luer Connector

The System Pressure Monitor (SPM) Luer Connector contains a 0.22µ filter to prevent the infiltration of contaminants into the disposable. It is intended to be coupled with the receptor on the SPM to assist in the monitoring of pressures within the bowl.

Note: **A wetted SPM luer connector indicates that the fluid pathway may potentially have been compromised. Discontinue collection of products, return contents of bowl to donor and discontinue procedure. The collected platelets must be used within 24 hours when stored at 20 to 24ºC; other blood products must be used within 24 hours if stored at 1 to 6ºC or within 4 hours when stored at 20 to 24ºC; product dating is not affected when the product is to be stored frozen.**

Hardware Descriptions

This section provides descriptions of the components included in the MCS+.

1. to 8. MCS+ pinch valves

Note: valve 3 is the "donor" valve or red-coded valve

9. AC pump
10. Transfer pump
11. Blood pump
12. Optical line sensor
13. Front Weigher
14. DPM
15. SPM
16. ACAD
17. BLAD

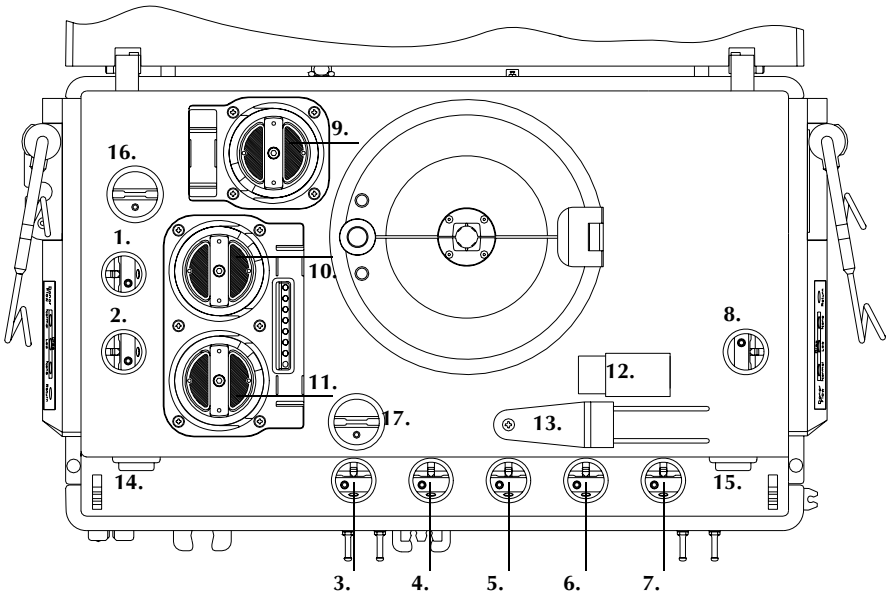


Figure 2-1, MCS+ top deck (eight valve machine)

Air Detectors

Anticoagulant Line Air Detector (ACAD)

The Anticoagulant Line Air Detector monitors the anticoagulant supply. This air detector detects whether the supply is depleted. The detector is immune to radiated or conducted noise such as that generated by motors, solenoids, or relays.

See *Donor Line Air Detectors* for the Anticoagulant Line Air Detector's circuit description.

Blood Line Air Detector (BLAD)

The Blood Line Air Detector monitors the tubing between the blood pump and the donor valve. In Draw, the detection of fluid in the tubing triggers the volume accounting function to begin (to exclude pumped air from the total volume processed). In Return, the detection of

air in the tubing triggers the end of the Return cycle (although additional volume is pumped to return the greatest quantity of red cells to the donor). The detector is immune to radiated or conducted noise such as that generated by motors, solenoids, or relays.

See *Donor Line Air Detectors* for the Blood Line Air Detector's circuit description.

Donor Line Air Detectors (DLAD1 and DLAD2)

The donor line air detectors provide an LED indicator when fluid is sensed. The detectors are immune to radiated or conducted noise such as that generated by motors, solenoids, or relays. The air detectors contain a self-test feature and are TTL compatible.

1 Donor Line Air Detector

The #1 Donor Line Air Detector (DLAD1) monitors the tubing between the #2 Donor Line Air Detector (DLAD2) and the donor. This sensor backs up the DLAD2 and should only detect air if the BLAD and the DLAD2 fail to do so. In Prime, the detection of fluid by DLAD1 triggers the completion of Prime.

2 Donor Line Air Detector

The #2 Donor Line Air Detector (DLAD2) monitors the tubing between the filter chamber and the DLAD1. This sensor backs up the BLAD and should only detect air if the blood line air detector fails to do so.

Circuit Description

The air detect signals are independently monitored by both the CPU and the safety card. The signal is +5 VDC when the air detector senses fluid, and is pulled to ground when sensing air.

CPU

The four air detector signals (ACAD, BLAD, DLAD1, and DLAD2) are pulled down, buffered, and read by the CPU. These signals are also latched and read by the CPU. The output of the four latches is connected to a NAND gate, which drives an interrupt to the CPU.

Safety Card

The safety card monitors three of the air detector signals: ACAD, DLAD1, and DLAD2. These signals are split into two isolated channels and terminated to ground through resistors. If any of the detectors are not connected, the input signals indicate air. Air signals are buffered and filtered, and read by the Safety Card.

The presence of air is registered if any of the following conditions exist:

- Air in the ACAD in Draw state.
- Air in DLAD1 in Return state.
- Air in DLAD2 in Return state.

Two (1) second timers start whenever air is sensed. If time-out occurs, the corresponding fault is presented to the fault registers and the procedure is aborted by opening the pump power relays. All three air signals are latched for reporting purposes.

Bar-code Reader

The bar-code reader is mounted on the left panel of the MCS+ device and can be used to enter the following types of data directly into the data storage memory.

- Disposable set lot and list number.
- Anticoagulant and solution bag codes.
- Donation number, donor number and operator code.

Note: **The Postscript to the MCS+ contains further information on the use of the bar-code reader when entering data, as well as the role of the communication box (discussed later in this chapter), in the transfer of this data to an external device or to HaemoNet, the Haemonetics communication network.**

Warning! **The class II bar-code reader emits laser radiation. Do not look directly into the beam.**

Centrifuge, Vacuum

The MCS+ uses a sophisticated centrifuge assembly that offers key operational features. The centrifuge cover halves have two independent interlock switches and are gear coupled and hinged to provide exceptional access to the centrifuge well.

The cover halves also secure the bowl header in place. A pair of microswitches report on the position of the cover latch mechanism. The bowl optics lens, used to monitor the cell separation, is mounted in the centrifuge well as is a fluid sensor used to detect moisture. Bowl mounting is accomplished with a vacuum system that firmly holds the bowl base to the centrifuge spindle. Vacuum leaks caused by a faulty or failed centrifuge rotary seal can be corrected with the seal replacement kit (Part Number 37210-00). Excellent drainage is provided in the event of a fluid spill, which terminates in a disposable waste bag.

The centrifuge speed is controllable up to 7000 RPM. Its motor is controlled by the Advanced Motor Driver PCB, discussed later in this section under Printed Circuit Boards.

Circuit Description

One microswitch controls a +15 VDC signal, and the other microswitch controls a +28 VDC signal. Both signals are used by the Advanced Motor Driver PCB to energize a relay, which directly controls the +48 VDC centrifuge drive source. Both signals are then optically isolated and monitored on the Advanced Processor PCB through an I/O port.

Centrifuge, Mechanical

The MCS+ uses a sophisticated centrifuge assembly that offers key operational features. The centrifuge cover halves have two independent interlock optical sensors and are gear coupled and hinged to provide exceptional access to the centrifuge well.

The cover halves also secure the bowl header in place. A pair of optical sensors report on the position of the cover latch mechanism. The bowl optics lens, used to monitor the cell separation, is mounted in the centrifuge well as are two fluid sensors used to detect moisture. One sensor is at the base of the centrifuge well the other at the top. The mechanical chuck centrifuge secures the rotating bowl by using six movable fingers which contact the shoulder of the bowl base. The holding force is created by centrifugal force generated by the fingers due to rotation of the chuck. The design of the fingers is such that the point of rotation is closer to the top portion which contacts the bowl than the lower section which swings outward. The design increases the holding force as rotational speed increases. Excellent drainage is provided in the event of a fluid spill, which terminates in a disposable waste bag.

The centrifuge speed is controllable up to 7000 RPM. Its motor is controlled by the Advanced Motor Driver PCB, discussed later in this section under Printed Circuit Boards.

Circuit Description

One optical sensor controls a +15 VDC signal, and the other optical sensor controls a +28 VDC signal. Both signals are used by the Advanced Motor Driver PCB to energize a relay, which directly controls the +48 VDC centrifuge drive source. Both signals are then optically isolated and monitored on the Advanced Processor PCB through an I/O port.

Centrifuge Control Description (Vacuum and Mechanical)

Main Loop

The Advanced Motor Driver PCB employs a closed loop velocity control system. Its operation is as follows:

- The CPU transmits digital speed information to the D/A converter which in turn produces an analog output proportional to this speed. The scale factor is chosen so that the code FFFh (10V out) = 10240 RPM.
- The analog voltage is next divided so that 3.65V is the full scale input applied to the Velocity Control Circuit (VCC).
- An analog feedback signal proportional to centrifuge velocity (Tach Feedback) is also provided. This is accomplished by producing a fixed on-time pulse whenever any of the three Hall Effect Sensor transitions.
- A potentiometer (R48) is used for final calibration as follows (no bowl assumed):
  - Output a digital code of 7D0h to speed register.
  - Enable Centrifuge.
  - After steady state speed is reached, adjust R48 until frequency output measured at TP1 (P5) is 1500 Hz (+/- 15 Hz.)
  - Verify speed is equal to 5000 RPM (+/- 50 RPM) using a tachometer.
  - The Tach Feedback is subtracted from the analog input “setpoint.” The difference is applied to a brushless motor controller, which in turn adjusts the centrifuge phase drives to control the centrifuge speed.

- The lower phase drive signals are directly applied to a power MOSFET stage while the upper drives are first buffered and level translated.
- The acceleration time for the centrifuge is: < 7 seconds (0-4800 RPM).
- The deceleration time for the centrifuge is: > 10 seconds and < 40 seconds (4800-0 RPM).
- The current draw generated by the centrifuge during acceleration with a Latham bowl filled with water is: < 2.5 amps max @ 4800RPM. The steady state current draw is:< 1.0 amps max @ 4800RPM.

Over Current

Current limiting on a PWM cycle basis is achieved by feeding back a differential voltage signal proportional to the output current. The nominal current limit is set for 3.1 amps.

Over Temperature

Over temperature limiting is obtained in the same manner as the pump drivers. An LM235 measures heatsink temperatures and outputs a voltage proportional to it. This level is compared to a voltage to represent an effective temperature of 90°C. If the temperature is exceeded, the Centrifuge Overtemp signal latches at a logic high, indicating a fault. To clear this fault, issue the Cent Overtemp Reset. This bit is available through Port 30Ah.

Over Speed

Overspeed is checked locally by filtering the Centrifuge Tachometer output and comparing this voltage with a level representing approximately 8000 RPM. If an overspeed condition is sensed, the signal Centrifuge Overspeed is latched High. The provision to clear this flag is on Port 30Ah.

The CPU can independently check centrifuge speed by accumulating the Hall B output pulses from the centrifuge motor in the 82C54 Counter I.C.

Centrifuge Enable and Brake Controls

A direct centrifuge enable/disable is provided by Port 30Ah D0 (High=Enable). An indirect disable occurs whenever the brake bit D1 of Port 30Ah is set.

The Brake command (setting Bit D1) is a “pulse brake,” meaning a duty cycle (pulse position modulation) control of braking. Normally, Timer 2 of U52 (82C54) is set up during power up in the divide by N mode (Mode 2 with N=8). Whenever the brake bit is set, the output pulse train is gated and then applied to the brake input.

Note that a change of Mode to Timer 2 can be used to implement a continuous brake signal application, also called a “hard brake.” An adjustable brake time is achieved by pulsing the brake input of the centrifuge motor control chip by varying the duty cycle of the brake signal from 50% to 99%. A “hard brake” is possible but not recommended except for speeds under 4000 RPM. To perform a hard brake, a bit and a control word must be written in order for a hard or pulsed brake to occur. A brake time of approximately 3 to 50 seconds results based on the duty cycle range and the criteria of the load/no-load conditions, as well as a centrifuge speed of 6000 RPM.

Cover Switch Connector

A four position socket AMP mini-universal connector is used for the cover switch connector. The pinout is detailed below:

1-- +28 Volts
2-- +28 Volt, cover sensor feedback
3-- +15 Volt, cover sensor feedback
4-- +15 Volts

Centrifuge Motor/Tach Connector

A nine position AMP connector is used for the centrifuge motor/tach connector. The pinout is detailed below:

1-- Hall Effect A
2-- Hall Effect C
3-- Hall Effect B
4-- Shield
5-- +15 Volts
6-- System Ground
7-- Motor Winding A
8-- Motor Winding C
9-- Motor Winding B

Cuff

The cuff is a rubber bladder, inflated by an on-board compressor and used to increase venous pressure at the needle site during Draw. The connection of the cuff tubing is off the middle of the back panel with the tubing long enough to accommodate both left and right hand donors.

When donor pressure is in the “Low Flow” state, the cuff toggles between ON and OFF at the rate of once per second (the CUFF key can be used to disable the toggling). Once the pressure increases beyond this state, the cuff stays in the ON position. Once the pumps have stopped completely, the cuff stays in the OFF position.

Cuff Compressor

The cuff pressure can be controlled and regulated automatically or manually within a range of 0 to 100 mmHg. The cuff pneumatic connection is located on the rear access panel. A pneumatic line directs the cuff pressure generated by a compressor located at the base of the MCS+ cabinet.

The compressor pressure is monitored by a cuff pressure sensor located on the Advanced Personality PCB and regulated by the Advanced Processor PCB software. When desired pressure is attained, the compressor speed is controlled to maintain the desired pressure level. The cuff is capable of delivering up to 120 mmHg of pressure using the proportional control algorithm.

Circuit Description

The CPU writes commands to a D/A converter located on the Advanced Valve Driver PCB. The output voltage (0 to 10 VDC) is then multiplied by a factor of two and is switched to the compressor through a transistor. The actual pressure is read through an op amp on the Advanced Processor PCB from the pressure sensor. The output of the op amp is connected to an analog DE multiplexer. The output from the DE multiplexer is connected to the input of the sample and hold amplifier. Its output is connected to input of the A/D converter, where the information is used to control the cuff compressor.

DPM/SPM

The donor pressure monitor (DPM) and system pressure monitor (SPM) are pressure transducer devices used to measure pressure over a range of +/- 250 mmHg in the disposable set at two key locations.

The DPM measures the pressure generated by the donor venous pressure (enhanced by the use of the cuff), at the inlet of the MCS+ blood pump. This pressure measurement represents the donor blood flow and is used to control the pumps in Draw and Return.

The SPM measures pressure at the outlet of the bowl which is generated by pumping fluids in the bowl and changing the speed of the centrifuge, such as acceleration or braking. This pressure indicates whether excessive positive or negative pressure has been generated inside the bowl.

Both monitors have sensors that monitor the position of the white sleeve. The sleeve is pushed in when the disposable filter is mounted. The position sensor reports on the position of the sleeve to indicate that the filters are properly installed.

Circuit Description

Pressure sensing circuit

The gauge pressure sensor, used to monitor pressure, produces an output of ± 100 mV for an input of ±15 psi. A ten-volt reference provides excitation voltage, while a differential amp buffers and scales the sensor output so that ±512 mmHg results in a ±2.4 volt level. For test purposes, test signals LOW TEST and HIGH TEST are provided. When LOW TEST is active, a resistor is selected to unbalance the bridge sensor, providing the equivalent of a -150 mmHg pressure input. When the HIGH TEST is active, a second resistor provides the unbalance, providing the equivalent of a +390 mmHg pressure input.

The two pressure signals are read into the Advanced Processor PCB through the Top Deck Distribution PCB and the Advanced Backplane PCB. The input is fed through an op amp to an analog DE multiplexer. The output from the DE multiplexer is connected to the input of the sample and hold amplifier. Its output is connected to input of the A/D converter, where the information is used to control the pump speed (DPM input), or to respond to a bowl system over pressure (SPM input).

Both sleeve position circuits

Hall effect sensors detect the magnetic field of a magnet mounted on the sliding filter sleeve. When the sleeve is extended, the interlock signals measure +5 VDC. When the sleeve is depressed and the hall effect sensors detect the magnetic field, the interlock signal is pulled to ground. Donor pressure interlocks 1 and 2 and system pressure interlocks 1 and 2 are pulled up by a resistor network. The interlocks are then isolated through a second resistor network where they are buffered and read into the CPU via an I/O port.

DPM sleeve position circuit only

The donor pressure monitor sleeve position sensor is also monitored by the safety card. The signal is pulled up to +5 V through a 10 K resistor. The signal is split, isolated, buffered, and ultimately monitored by the safety circuitry. When the interlock indicates that the filter is not mounted, a one-second timer is started to allow the CPU to report the condition. If time-out occurs, the safety card opens the safety relays and reports the safety system fault.

Drip Monitor

The drip monitor informs the operator that anticoagulant is flowing. It uses maximum detectable input sensing with a drop rate of 12 drops/second (40 ml/minute) and illuminates a yellow LED for each drop detected. The LED also illuminates during a test activation.

The drip monitor provides digital output to the operator such as the conversion factor (for pumps between 1.5 to 20 ml/min.) and drops/sec. = 0.3 X ml/min. +/- 15%.

Circuit Description

The drip monitor operates on +5V, <150 mA. It contains a vertical channel that has an open slot in front and two opposing windows on the sides. Outside one window is an Infrared (IR) Emitter, and outside the other is an IR Detector. Energy transmitted from the Emitter passes through the first window and into the channel. After crossing the channel, this energy passes through the second window and is collected by the IR Detector. A single output pulse is generated anytime an object interrupts the IR signal.

In normal operation an anticoagulant (A/C) drip chamber (part of the disposable) is inserted into the drip channel. Whenever A/C flows properly, drops are created and forced to travel through the IR Emitter/Detector sensing axis. In this situation, the drip monitor outputs one pulse per drop and the CPU can verify flow by counting the number of pulses per unit time.

Fluid Sensor

The +10 VDC fluid sensor signal is isolated by a resistor, buffered, and read through an I/O port on the Advanced Processor PCB. The fluid sensor power input is 10 VDC. The output is TTL. There are two fluid sensors for the mechanical chuck.

IV Pole

A single pole, consisting of two sections, is attached to the left handle of the MCS+. The bottom section is hollow to receive the top section. Pulling up on the bottom section extends the pole to 14″ high. To release the latch, push the latch button and push the section down until it bottoms out. The bottom section also has a hook for holding anticoagulant solutions. This hook is made of stainless steel and has its own latch mechanism that allows the hook to move up and down on the lower pole to various latched positions. The latch operates the same as the handle latch: raise to lift, push button to lower.

The upper pole section is a solid stainless steel rod with a hook for hanging solutions. The pole is raised by lifting the pole to the latch position at the top of the bottom pole section. This raises the top pole to 12 1/2″. To lower the top pole, push the latch button.

Both poles swivel 360° about their axis. The IV pole can hold up to 5 liters of fluid hanging from either hook. There is also a pole on the right side of the machine for continuous filtration.The IV pole fully retracts into its handle for easy storage.

Line Sensor

The line sensor is an optic system used to monitor fluid exiting the bowl through the effluent line during Draw and Surge. (Surge is an elutriation process where collected plasma is pumped into the bowl at a high flow rate, causing the accumulated platelets to evacuate the bowl.) The line sensor signal, which generally measures the density of the fluid, indicates the platelet concentration of the effluent fluid. As the concentration increases, the density increases, and the signal voltage decreases. This information is used to control the pump speed during Surge to optimize the platelet collection and to determine when to end Surge.

The light from a single red LED is transmitted though a diffuser lens, which is located in the tubing channel of the line sensor case. When the effluent tubing is inserted into the line sensor, the diffuser lens directs the light though the tubing walls. A second diffuser lens is located directly opposite the transmitting lens, which picks up the transmitted light. The receiver lens directs the transmitted light to a photoelectric detector, which converts the light to an electrical signal. As the amount of received light increases, the line sensor signal also increases.

Circuit Description

The line sensor signal can range from 0 to +10 VDC analog output, but normally ranges from 0 to +8 VDC. The signal is fed to the platelet line op amp buffer circuit on the Advanced Processor PCB. The op amp halves the line sensor voltage signal to 0 to +5 VDC, where it is then DE multiplexed, sampled, and input to the A/D converter, which presents the optic information to the data bus.

Membrane Panel

The membrane panel is the main user/instrument interface. Color coding, icons, and graphs are used with alphanumeric data to communicate procedural information to the operator. The HAEMOCALCULATOR/HELP key provides the operator with additional information.

See the User Interface section of Chapter 3, Principles of Operation, for more information on specific keys.

Figure 2-2, MCS+ Membrane Panel

The membrane panel uses traditional membrane keys that are fluid-proof and easy to use. All keys, except the pump control keys, have an associated LED that lights up when a key has been pressed. Each time an ACTIVE key is pressed, the MCS+ emits a short beep to confirm recognition of a pressed key.

The control panel is comprised of three main components: a membrane panel, an electroluminescent display module, and a display distribution board. The membrane panel is a key matrix membrane mounted to a printed circuit card. The matrix is electrically connected to the display distribution board.

The membrane panel display is a low power, rugged, high-resolution electroluminescent display which replaces the bulky CRT display. The display is designed to function in extreme environments, and its crisp display is viewable at wide angles.

The display is a 320 column by 128 row flat panel display. The pixel ratio is 1:1 and the CRT-type interface is TTL-compatible. This display may be driven at frame rates up to 110 Hz for applications requiring extra brightness.

The display is physically mounted to this PCB. The associated power supply PCB can either be mounted to the membrane panel PCB or remotely (to reduce overall module thickness). The display is a display device that receives commands from the CPU through the display distribution board and generates characters to communicate information to the operator. The display distribution board coordinates signals between the CPU and the control panel display. The display distribution board manages keyboard and LED information transfer between the distribution board and the CPU.

Photoelectrics

The optical system places a 0.1 inch diameter beam of 650 nM light in the space between the inner core and outer shell of the bowl. The optic beam is set at a specific elevation and angle to the bowl, causing light to be reflected from the bowl surfaces back to the optic lens. The reflected light is transformed to an analog voltage and presented to the CPU. The reflected light is used to determine when to initiate various events based on the fluid and cellular levels in the bowl.

The system consists of the following three components:

Photoelectric Assembly

This electro-optical device modulates a red LED to create a light source at 650 nM. This light source is carried to the optic aiming module by a bifurcated fiber-optic cable. A photosensitive transistor is positioned to look at the returned light. The resulting electrical difference is amplified and presented as an analog signal output that is used by the CPU.

Optic Aiming Module

The optic aiming module houses one end of a bifurcated fiber-optic cable, a mirror, and a lens to focus the light to and from the bowl surfaces. The aiming module is housed in the centrifuge well, and its position is adjustable to provide optic alignment capability.

Fiber-optic Cable

A randomized bifurcated glass fiber-optic cable is used to transmit the light produced in the photoelectric device to the optic aiming module and to return the reflected light back to the photoelectric device.

Circuit Description

The optic signal generated by the Omni-beam photoelectric block model (#OPBT3-27583) ranges from 0 to +15 VDC at 100 mA. The signal is fed to the bowl optic op amp buffer circuit on the Advanced Processor PCB. The op amp buffer halves the optic voltage signal from 0 to +5 volts DC, where it is then DE multiplexed. A potentiometer (R1), located on the Advanced Processor PCB, adjusts the offset voltage on the bowl optic buffer output. The output is sampled then input to the A/D converter, which presents the optic information to the data bus.

The combination of the op amp, optics cable, and optics assembly can produce an allowable DC voltage offset up to 1 volt DC. An offset null circuit is provided on the Advanced Processor PCB. The potentiometer (R1) is used to null out the optics offset. The output range of the photoelectric assembly is regulated to supply requirements of the Banner Sensor head (#OSBFVH-27453) of 0 to 10 volts DC, with a maximum allowable DC offset of 1 volt. The buffer circuit halves the input voltage through an op amp. Therefore, the optics output range presented to the A/D converter is 0 to 5 volts DC, with a maximum offset of 0.5 volts DC.

Pinch Valves

The valves used by the MCS+ are controlled by the Advanced Processor PCB using the pneumatic assembly to control the flow of air/fluid through the disposable set and to accommodate its protocols. Air generated by a compressor is distributed from the assembly (through solenoids and pneumatic tubing) to the individual valves, causing them to open or shut. The valves function at a minimum operating pressure of 18 psig. Normal pressure is available between 20 and 25 psig.

The donor/red valve controls fluid flow from the donor to the bowl, or vice versa. The blue valve controls fluid flow from the plasma bag to the bowl. The yellow valve controls fluid flow from the bowl to the plasma bag. The green valve controls fluid flow from the bowl to the platelet bag(s). The white valve controls air management. The orange and purple valves are used primarily for replacement fluid control in the Therapeutic Plasma Exchange (TPE) Protocol. Fluid passes through the respective valve, depending upon the user's specification, via gravity to the replacement bag. This bag is hung on the weigher and the transfer is monitored as such.

Pinch valves are spill proof and quickly occlude tubing. The pinch valves hold against 300 mmHg of pressure deadened without leaking. The power off occlusion is operated by a spring mechanism.

The top loading pneumatic pinch valve is designed for occluding disposable PVC tubing and allows for a +/- 10% variation of tubing dimensions and grade.

Position sensing is done using a solid state proximity sensor, meaning there are no mechanical parts. The MCS+ provides easy installation of the disposable without having to open the valves.

Circuit Description

The MCS+ uses Hall Effect-type electronics to determine valve position. The Advanced Valve Driver PCB includes the circuitry needed to control the valves using high current latched drivers (UCN5801).

Pneumatic valves require 20mA of current at 24 VDC. Since a 28 volt supply is used in the MCS+, 4 volts (28 VDC minus 24 VDC = 4 VDC) is dropped across 220 ohm resistors connected in series with each valve. These resistors also provide a convenient place to measure valve current. When a valve is energized, a voltage is developed across a series resistor. This voltage serves as a direct indication of the presence of current through the valve. Multichannel optoisolators are used to convert voltage information into a digital form available for the CPU to read using U7 (address 343H) and U11 (address 344H).

The MCS+ uses proximity sensors (922LC) for feedback purposes. If a valve is closed, or de-energized, the feedback is Low. U26 (address 345H) and U27 (346H) provide the feedback information to the CPU. Feedback signals are pulled up and filtered to improve noise immunity.

Pneumatics Module

The Pneumatics Module is a self-regulated assembly mounted to a frame support, consisting of the following:

- Pneumatic Compressor
  The function of this compressor is to pressurize the air accumulation chamber used for valve activation upon command. Control the compressor by writing the “on” or “off” command to the U18 (address 342H) BiMOS octal high voltage, high current latched driver.

  This compressor requires 24 VDC at 150mA to run. D5 (3.9V zener diode) is used to bring the supply voltage of 28 VDC to this level. A voltage drop across the zener provides an indication of the compressor state. This information is available to the CPU at U11 (address 344H).
- Control PCB pressure sensor with a supply voltage of 24 VDC at 500 mA and 15 VDC at 30 mA. The Control PCB on command is optional. The pressure sensor is a Microswitch 185 PC 30 DT with 60 psig Max.
- Gold anodized aluminum pressure tank with a capacity of 14 cubic inches and a 50 psi minimum burst pressure.

Power Entry Module

The power entry module consists of a power switch, an AC cord receptacle, and an RFI filter. AC power is directed to a line filter and terminates at the DC power supply. An outer panel can be pried open from the top, giving access to two input fuses (250V 5A @ 110V configuration/2.5A @ 240V configuration).

AC Input Line Filter

The AC input line filter reduces conducted line emissions to bring the MCS+ into compliance with FCC and TUV emission standards. These line emissions are generated by high-frequency signals emanating from the power supply, Advanced Processor PCB, motors, and drive circuitry, among other components. The line filter also protects the power supply and internal machine electronics from noise spikes on the AC line. These noise spikes are generated by various components such as compressors, during power-on. The noise spikes could cause erratic machine operation including resets and operational faults.

Power Supply

There are currently two types of power supply for the MCS+. Power Supply I is manufactured by Todd and Power Supply II is manufactured by Condor.

Power Supply I (Todd)

The MCS+ is equipped with a switching power supply that satisfies all the power requirements of the system. The MCS+ shows a green LED fault indicator. When the green light is on, the power supply is active; when off, the power supply is inactive.

The input protection is internally fused with an over voltage protection of +5V output with a maximum of 6.8 volts.

Trim pot R22 is used to adjust the +5 VDC voltage level.

Voltage levels must be set with a maximum load applied; therefore, it is recommended that the supply is adjusted only after installation into the MCS+.

The supply voltages are adjusted at the supplier and should require only minor calibration. All outputs are protected against overload and short circuit. Recovery is automatic when the fault is removed.

Table 2-1 shows the MCS+ Power Supply I (Todd) specifications.

Table 2-1: Power Supply I (Todd) Specifications

Factor	Specification
AC Input	User Selectable (Switch located near AC input entry) 80 - 132 VAC or 160 - 264 VAC 47 - 63 Hz.
Inrush Current (cold start)	50 Amps (max.)
DC Outputs	#1. +5.1V @ 10 Amps/1.5 Amps Min. Load #2. +15V @ 1.5 Amps #3. -15V @ 0.5 Amps #4. +28V @ 4 Amps / 6 Amp Peak and No Min. (Peak -- 1 sec. duration Max, Repetition rate not to exceed a 10% Duty Cycle) #5. +48V @ 2 Amps / 4 Amp Peak and No Min. (Peak -- 10 sec. duration Max, Repetition rate not to exceed a 10% Duty Cycle)
Tolerance @ 25°C (All outputs @ 60% load)	#1. +/- 2% (Adjustable) #2. +/- 2% #3. +/- 2% #4. +/- 5% #5. +/- 5%
Ripple	+/- 1% or 100 mV. pk. -pk to 20 MHz Bw, whichever is greater.
Maximum Combined Output Power	150 Watts / Convection Cooling 200 Watts / 30 CFM Air Flow 300 Watts / 100 CFM Air Flow

Table 2-1: Power Supply I (Todd) Specifications (Continued)

Factor	Specification
Mechanical (Size not to exceed)	Size: 2″ H x 6″W x 8″L Weight: Approximately 2.5 lb. Connections: Inputs for AMP Ultra-Fast Plus .250 series FASTON Receptacles. Outputs via AMP Mini-Universal MATE-N-LOK Connector (770613)
Efficiency	80% typ. with 70% loading
Holdup Time	20 m sec. after nominal AC loss
Overvoltage Protection	5.1 V output (6.8 V max)
Temperature Range	0 to 50°C (Operating) -25 to 95°C (Storage)
Leakage	< 100 µ Amps as measured per U.L. 544 and 2601
Shock	Mil-Std. 810-D method 516.3, Proc. III
Vibration	Mil-Std. 810-D method 516.3, Cat. 1, Proc. I

Power Supply II (Condor)

The MCS+ is equipped with a switching power supply that satisfies all the power requirements of the system. The MCS+ is equipped with a green LED fault indicator. When the green light is on, the power supply is active; when off, the +5V output is less than 4.85 VDC. There is an internal cooling fan built into the back panel of this power supply.

The input protection is internally fused with an over voltage protection of +5V output with a maximum of 6.8 volts.

The 5V ADJ pot is used to adjust the +5V output level. Voltage levels must be set with a maximum load applied; therefore, it is recommended that the supply is adjusted only after installation into the MCS+.

The supply voltages are adjusted at the supplier and should require only minor calibration. All outputs are protected against overload and short circuit. Recovery is automatic when the fault is removed.

Table 2-2 shows the MCS+ Power Supply II (Condor) specifications.

Table 2-2: Power Supply II (Condor) Specifications

Factor	Specification
AC Input	Automatic Selection 80 - 132 VAC or 160 - 264 VAC 47 - 63 Hz, single phase Fuse type: 250 VAC 10A
Inrush Current (cold start)	16 A^2 sec.

Table 2-2: Power Supply II (Condor) Specifications (Continued)

Factor	Specification
DC Output	#1. +5.1V @ 10 Amps/1.5 Amps Min. Load #2. +15V @ 1.5 Amps #3. -15V @ 0.5 Amps #4. +28.375V @ 4 Amps / 6 Amp Peak and No Min. #5. +48.650V @ 2 Amps / 4 Amp Peak and No Min.
Tolerance @ 25°C (All outputs @ 60% load)	#1. +/- 1% #2. +/- 2% #3. +/- 2% #4. +/- 4% #5. +/- 4% All outputs have a temperature coefficient no greater than 300 ppm per degree C. Adjustable via single turn potentiometer +/- 5% minimum.
Ripple and Noise	0.5% RMS, all outputs @ 100% rated load, with 0.1 of ceramic capacitors connected at power supply outputs. @ 20 MHz bandwidth. Measurements taken across capacitors with oscilloscope probe tip and ground ring.
Maximum Combined Output Power	150 Watts / Convection Cooling 200 Watts / 30 CFM Air Flow 300 Watts / 100 CFM Air Flow
Mechanical (Size not to exceed)	Size: 2″ H x 6″W x 8″L Weight: 3.5 lb. maximum Connections: Inputs for AMP Ultra-Fast Plus .250 series FASTON Receptacles. Outputs via AMP Mini-Universal MATE-N-LOK Connector (770613)
Efficiency	70% during 75% output loading
Holdup Time	20 mS @ nominal output after nominal AC loss
Overvoltage Protection	Maximum allowed V1 voltage of 5.6- 6.8 volts. Shutdown and latched all supplies.
Temperature Range	0 to 50°C (Operating) -25 to 85°C (Storage)
Leakage	< 100 µ Amps as measured per U.L. 544 and 2601
V1 output good	Green LED on for V1 greater than 4.85V
Output Termination Detail	PIN# Function Color PIN# Function Color 1 DC Common white 8 +5.1VDC red 2 DC Common white 9 +5.1VDC black 3 DC Common white 10 +15VDC green 4 DC Common white 11 -15VDC blue 5 DC Common white 12 +28.375VDC orange 6 DC Common white 13 +28.375VDC brown 7 DC Common white 14 +48.650VDC yellow
Weight	3.5 lb. maximum

Printed Circuit Boards (PCBs)

The card cage houses six of the MCS+ printed circuit boards (PCBs) to include:

- Advanced Processor PCB
- Advanced Motor Driver PCB
- Advanced Safety PCB
- Advanced Valve Driver PCB
- Advanced Backplane PCB
- Advanced Personality PCB

Advanced Display PCB

This PCB is the common interface between the MCS+ system card cage, the membrane panel, and its associated PCBs. Both the membrane panel and the Backlite PCB can be customized for each machine application both physically in shape, and by the number of circuits.

The Advanced Display PCB contains three areas of functionality: Display interface, Key switch input channeling, and LED output control. The display interface is common to all applications using the PLANAR EL4737LP display. The display is physically mounted to this PCB. The associated power supply PCB can either be mounted to the Advanced Display PCB or it can be attached remotely to reduce overall module thickness. All connections are via ribbon cables. The Backlite PCB acts as the common tie point to the Membrane Panel thereby making the interconnection to the Advanced Display PCB common. Additional I/O requirements are handled by a secondary connector on the Advanced Display PCB.

The Advanced Display PCB requires the following:

- Small X-Y footprint with provision for mounting the display and power supply
- Standard high density ribbon cable connection to the MCS+ Card Cage
- Maximum input/output configuration to include:
  - 32 poled inputs
  - 16 multiplexed outputs @ 250mA
  - 8 direct inputs
  - 8 direct outputs
- Direct display/key panel control interface PCB to Backlite PCB (no cable)
- 12 V regulator for display power
- 8279 for all multiplexed I/O
- Low height profile for electronic circuitry, subject to mechanical constraints

Advanced Processor PCB

The Advanced Processor PCB is a 386SX/EX 25 Mhz 32-bit processor which can be upgraded to more advanced CPUs by replacing the module. Its configuration memory is 2K EPROM. The Advanced Processor PCB includes 2MB DRAM, expandable up to 4MB and resident ROM-BIOS/DOS.

The Core Plug In of the Advanced Processor PCB features the following:

- 7 DMA (8237A compatible) / 15 Interrupt channels (8259 compatible)
- Three 16-Bit Programmable Counters, compatible with 8254
- PC/AT Keyboard Port and Real Time Clock
- Two serial ports (COM1and COM2) for internal and test functions, with 16 Byte FIFO on COM2
- One Bidirectional Centronics Parallel Port
- One PC speaker port 0.1W drive
- Hardware reset

The Main Board of the Advanced Processor PCB features the following:

- 2 MB (expandable to 4 or 8 MB) Flash EPROM for programming, calibration, and option memory with hardware and software Write protection and 32 KB Alias Region @ E0000h (MAPS to 700000h)
- 1 MB battery backed static RAM memory for Protocol, User Options, Recovery Data, and Program support and 32 KB Alias Region @ E8000h (MAPS to 400000h)
- 3.5 volt, 750 mAH lithium battery.

Note: **Consult the local standard procedure for proper disposal of lithium batteries. If needed, contact the local Haemonetics representative for assistance.**

- Hardware CRC accelerator
- Flat panel graphics interface with 64 KB Video RAM
- Floppy disk drive interface port supporting up to two drives of any mix of 3 1/2″ to 5 1/4,″ and support of 250 Kbps, 300 Kbps, and 500 Kbps
- Haemonetics Smart Card Interface with a full PCMCIA range of 64 MB, and featuring 1 MB Active window and I/I port used for page control
- Two additional serial ports for external use (COM3 and COM4), each with 32 Byte FIFO and IrDA Mode
- MCS+ II Standard Digital and Analog I/O Set
- Watchdog Control Logic

Table 2-3 shows the specifications for the Advanced Processor PCB.

Table 2-3: Advanced Processor PCB Specifications

Feature	Specification
Expansion	Two slots: PC/104 Compliant slot (3.6″ x 3.8″ Board) for CPU and generic expansion ISA Signal-Compatible slot (Circuit Side Mounted) for custom expansion
Special Test Function	PC Mode selection with an on-board hardware switch
Physical features	Form factor 6.3″ x 7.8″
Electrical	Power requirements less than 8 Watts total Safety per IEC-601-1

Advanced Processor II PCB

The Advanced Processor II PCB Assembly, P/N 39783-00 Rev. J, is presently used in the MCS+ LN 9000 series of Haemonetics machines. This PCB Assembly functions as the main control for electronics in the MCS+ LN 9000 machines. This PCB Assembly was designed in 1995 and is nearing end of life because of obsolete components.

The LN 9000 CPU PCB Assembly, P/N 50846-01 Rev. A, has been designed as an equivalent Form, Fit and Function replacement for the P/N 39783-00 Advanced Processor II PCB Assembly. Table 2-4 lists the differences in features between the 39783-00 and 50846-01 PCB Assemblies.

Table 2-4: Differences in Features, 39783-00 and 50846-01 PCB Assemblies

Feature	39783-00 Rev. J	50846-01 Rev. A
Component count	475 parts	336 parts
CPU core	49015 Rev. A Ampro Core Module 3Sxi-25	49015 Rev. A Ampro Core Module
DRAM	2MB	4MB
Secondary memory	None	96MB Solid state disk
ROM	2MB Flash EPROM	4MB Compact Flash Card
Display control	4-bit LCD controller	4-bit or 8-bit LCD controller
PC/104 slots	Two (2)	One (1)
Mode switches	Three (3)	Six (6)
Optics bus	None	16-bit
Serial optics port	None	(COM2)
Floppy disk controller	One (1)	None
Weigher inputs	Three (3)	Two (2)
Extra pressure inputs	One (1)	None
Pressure interlocks	Six (6)	Four (4)

The 50846-01 PCB Assembly was originally targeted at the LN 9500 MCS+ Pro Platform. This is the reason for the Optics Bus and Serial Optics Port.

The 4MB Compact Flash (CF) Card contains the Loader Program, which was stored on the now obsolete 2MB Intel Flash EPROM on the 39783 PCB.

The CF Card seamlessly integrates into the LN 9000 operating system environment and allows for quick updates to the Loader Program, if necessary.

There is an additional 2MB DRAM for possible future implementation of a Real-Time Operating System.

The 96MB Solid Sate Disk (SSD) is intended for use in a yet-to-be-designed Data-Logging System designed to replace the “Easi-Disk” system.

The 39783-00 had some extra Analog and Digital Inputs which have been deleted on the 50846-01. And finally, the 39783 had an extra, unused PC/104 slot. Another set of mode switches were added to the 50846-01 enabling ROM WRITE and DOS BOOT.

Advanced Personality PCB

The function of the Advanced Personality PCB is to interface all of the card cage I/O to its ancillary components. This is a passive board with the exception of the cuff pressure transducer. There are also provisions for power supply monitoring and measuring using 10K ohm isolation resistors.

The following components directly connect to the Advanced Personality PCB: weigher, pressure transducer, dump valve, spill detector, centrifuge cover switches, bowl optics, fans, vacuum pump, cuff compressor, centrifuge motor, and chassis ground termination.

The Top Deck Distribution PCB and the Display Distribution PCB connect to the Advanced Personality PCB.

Advanced Backplane PCB

The Advanced Backplane PCB mounts to the card cage which houses a standard set of four capital boards (with the exception of the Advanced Safety PCB which is application/system specific) including the Advanced Processor PCB, Advanced Valve Driver PCB, and the Advanced Motor Driver PCB.

The Advanced Backplane PCB allows communication between all of the capital boards as well as breaking out all of the I/O functions of the boards using four sets of three-row headers. The Advanced Personality PCB plugs into these headers and is particular per system. The Advanced Backplane PCB is therefore, a passive board and allows communication between its card cage boards and a host computer. A test connector connects an optional computer bus to the backplane bus for testing purposes.

The power supply connector introduces and allows the Advanced Backplane PCB to distribute the necessary DC voltages to all card cage and personality boards. Those voltages, all referenced to SYSGND are as follows: +5 VDC, -15 VDC, +15 VDC, -15 VDC, +28 VDC, and +48 VDC.

Advanced Motor Driver PCB

The Advanced Motor Driver PCB supports the combination of three brushless type motors. It has two “smart” solid state relays which are employed for the protection of the pumps against under voltage, over current, thermal sensing, and fast (no bounce) response, and another relay for the centrifuge.

This PCB also monitors the temperature of all sinks and de-energizes the safety relay if over temperature is sensed.

The main function of the Advanced Motor Driver PCB is to interface the Advanced Processor PCB to the following system components: pump motors, centrifuge interface, and safety system relays.

Commands written from the CPU are processed on the Advanced Motor Driver PCB, and the above components are driven by the circuitry contained on the PCB. The PCB also serves as an interface between the feedback signals of the pump, centrifuge, and relay systems to the CPU and safety cards.

Table 2-5 shows the specifications for the Centrifuge control portion of the Advanced Motor Driver PCB.

Table 2-5: Advanced Motor PCB Specifications

Component	Specification
Control Type	Velocity Loop - Digital Signal Processor (DSP-PID)
Input	Set point via 12 bit DAC 0 to 5V loop control range
Scale factor	Digital code FFF = 10240 RPM (FSR)
Angular Velocity Usable Range	200 RPM to 8250 RPM with or without Adapter
Initial Accuracy (includes linearity)	1.5% of FSR
Resolutions	.01%
Acceleration Time (full bowl 0 to 6000 RPM)	> = 10 seconds
Velocity Load Reg.	0.1% of FSR (no bowl to full bowl)
Overshoot	< 1% of FSR (full scale step)
Temperature Stability	0.1% of FSR (TA from 18 to 30×)
Set Speeds	4,800 RPM with 250ml Latham Bowl 7,000 RPM with 275ml BMCT Bowl
Short Term Stability (15 minutes)	.1% of FSR
Tach Output	18 Pulses/RPM
Aux. Control Sigs.	Two: Enable and Brake
Current Draw	3.5 Amps Max (Accelerating) 1.0 Amps (Steady State)
Current Limit	4.0 Amps (Steady State)
Under Voltage Lockout	40V Centrifuge Power Minimum
Over Speed Protection	8,250 RPM (Hardware) / 7,500 RPM (Software)
Power	48 VDC +/- 15%
Rotation	Clockwise

Advanced Valve Driver PCB

The Advanced Valve Driver PCB is located in the second from right position in the Card Cage. The function of the Advanced Valve Driver PCB is to interface the Advanced Processor PCB to the following components:

- Pneumatic Valves (any combination of up to 12)
- Vacuum Pump (24 VDC)
- Cuff Compressor (0 to 20 VDC analog drive)
- Pneumatic Compressor ((24 VDC)
- Dump Valve (24 VDC)
- Donor Lights (15 VDC)
- Safety Relay (Solid State)
- Disposable ID Interface (transmit and receive)

This PCB supports the pneumatic pinch valves. These valves are typically used to supply air under pressure to an air cylinder. The under pressure air cylinder overcomes the spring and allows the tubing to be unclamped.

The Advanced Valve Driver PCB provides control and monitoring for the Vacuum Pump, Cuff, and Pneumatic Compressors.

The Advanced Valve Driver PCB positions feedback using high reliability proximity detectors to indicate magnetic flux change. It also employs a solid state pump/valve “smart” relay protection for conditions such as under voltage, over current, and thermal sensing as well as interfacing with disposable ID electronics and donor light ports and drivers.

Circuit Description

BiMOS high voltage, high current latched drivers (UCN5801) are used for driving the pneumatic valves. The bipolar/MOS combination provides an extremely low-power latch with maximum interface flexibility.

U9 (address 341H) controls Valves 1 though 7. Pneumatic valves require 20mA of current at 24 VDC. Since a 28 V supply is used in the MCS+, 4 volts are dropped (28 VDC minus 24 VDC = 4 volts) across 220 ohm resistors connected in a series with each valve. (RN6, RN3, and RN9). These resistors also provide a convenient place to measure valve current. When a valve is energized, a voltage is developed across a series resistor. This voltage serves as a direct indication of the presence of current through the valve. Multichannel optoisolators (U8, U6, and U10) are used to convert voltage information into a digital form available for the CPU to read using U7 (address 343H) and U11 (address 344H).

When a valve is closed (de-energized), the feedback is Low. U26 (address 345H) and U27 (address 346H) provide feedback information to the CPU. Feedback signals are then pulled up and filtered to improve noise immunity.

Advanced Safety PCB

The Advanced Safety PCB is an independent safety monitoring system used to ensure that the MCS+ always operates in a normal operating condition. It accepts direct CPU information as to machine state; independently verifies the state using the pump encoder and valve feedback signals; and tests all appropriate sensor safety limits including air detectors, as defined for the state. If a fault is detected, it removes power from both the pumps and the valves using relays on the Advanced Motor Driver PCB. The Advanced Safety PCB sounds a unique alarm and provides the CPU with information describing the problem.

The safety relay controls the power applied to the pumps and the valves. This relay is opened whenever a fault condition is indicated by the safety system. The safety relay is a solid state relay which controls the power to the pumps and the valves. The Advanced Safety PCB produces the necessary drive for the relay. A jumper forces the relay to energize in order to ease the troubleshooting and testing procedures.

The Pump Relay also controls the power applied to the valves and the pumps. This relay is opened whenever a fault condition is indicated by the CPU or safety system.

The Advanced Safety PCB provides machine state inputs for 3 pumps and 5 valves. Valves 6,7 (and 8 - if applicable) are not monitored by the Safety PCB. It uses machine inputs to determine the process state for the Disposable ID.

Table 2-6: Advanced Safety PCB Specifications

Component	Service Information
Centrifuge Safety Relay	Supports both cover switches and additional inputs (TDB) to control power. All logic is resident on the Safety PCB.
Safety Adjustments Due to Protocol	Smart Card, disposable “Classifier” and user can alter sensor selection and or safety limits
Fault Reporting	Faults, sensors levels, and pump and valve states and internal flags latched (id of first channel faulted)
Valve Induced State Faults	Valve position delay (200 to 400 m/sec) allows CPU to react
Pump Tracking Speed	> 1250 RPM
Beeper Usage	Alarm sounds during beeper testing
Implementation Technology	5 RAM based FFGAs and PROMS

Disposable ID PCB

The Disposable ID provides disposable and protocol information to the CPU as to the type of disposable installed on the system. Some of the safety parameters can be modified.

The raw ID code consists of 8 bit:

– 2 framing bits which are always 0 as soon as a disposable is installed (reflecting) except for some disposables of the LN 994CF family on which framing bits are equal to 1.
– 6 bits of code which always 3 zeros except for code 00000000 (LDP white manifold) and code 11111111 (FF) when no disposable is installed (no reflection).

Framing bit	6 bits	Framing bit

The disposable ID code consists only of the 6 intermediate bits (refer to Table 3-6, "Disposable ID Codes," on page 3-22, for the detailed list of codes).

Circuit Description

Eight reflective sensors (located on the Disposable ID PCB) extract ID information from the label attached to the bottom of the double-pump manifold. Any combination of 8 infrared emitting diodes can be powered by writing the data to U17 (shift register with parallel load at 349H). This write initiates a serial clock which is needed to shift the data out to the Disposable ID PCB. The data direction can be changed by writing a HI to D0 of octal latch at 34AH. The access generates a serial clock used to shift data into a parallel-out serial shift register. The information obtained from this procedure can be read by the CPU through address 34BH.

Donor Light PCB

The Donor Light PCB supplies LED indications for User/Donor information during Draw and Return. During Draw, Green indicates Normal pressure, Yellow indicates Low pressure, and Red indicates No Flow. During Return, Yellow indicates Normal pressure, and Red indicates No Flow or High Pressure.

Circuit Description

The donor lights are commanded by writing to the lower order nibble of address 348H0, BiMOS quad high voltage, high current latched driver. The current limiting is done by the resistors. The donor light assemblies use +15 VDC for current limiting.

Top Deck Distribution PCB

The Top Deck Distribution PCB interfaces all of the card cage I/O (via the Advanced Personality PCB) to its ancillary components and assemblies. The Top Deck Distribution PCB is a passive board with the exception of a solid state circuit (two TTL, Open, and Collector inverter packages) used to illuminate the LEDs located within the pneumatic valve assemblies.

This PCB also has a manifold to distribute air pressure from the compressor to the corresponding valves.

The following components connect directly to the Top Deck Distribution PCB: Drip Monitor, Pneumatics Compressor, AC Air Detector, Blood Air Detector, Donor 1 and Donor 2 Air Detectors, Blood Pump Motor, AC Pump Motor, Transfer Pump Motor, Spare Pump Motor, Chassis Ground Termination, Bowl Pressure Monitor, Donor Pressure Monitor, two sets of donor lights, Valve Solenoids, Line Sensor, Protocol ID, Valve feedback, and LEDs.

Pumps

The MCS+ uses three pumps consisting of a dual pump assembly and a single pump assembly. Two peristaltic pumps are used to move blood and anticoagulant through the disposable. The third pump is used during Surge and to return plasma and saline (optional) in the three pump protocol. The pump/tubing system is designed to pump approximately one ml per revolution and is capable of pumping up to 250 ml/min. (blood pumping). The anticoagulant pump turns 1/8 to 1/16 the speed of the blood pump, depending on the anticoagulant ratio selected.

Each pump rotor has two urethane pumping rollers and two plastic alignment rollers. The pumping rollers occlude the tubing against the pump rotor housing, while the alignment rollers keep the tubing centered on the pumping rollers. Each pump motor is required to be equipped with a quadrature encoder. The MCS+ is equipped with a 500 line encoder.

The pump motor is a 3 phase brushless DC motor. The power runs at 28 VDC +/- 15% at 3.5 amps max, 1 amp steady state. The speed ranges from 0 to 250 RPM.

The MCS+ supports any combination of up to 4 brushless or brush type motors. The brush type is equipped with a 500-line quadrature encoder for speed feedback.

Circuit Description

The CPU transmits the desired pump rate and direction to the Advanced Motor Driver PCB. The Advanced Motor Driver PCB compares the pump rate and direction to information received from the encoder and adjusts the motor's drive level (using pulse width modulation) to compensate for any error. Each motor driver has an independent enable input which gives the CPU direct control over the driver power. The interface is provided by U19, U28, and U33.

LM629

LM629 is a dedicated microprocessor peripheral which performs all the control functions for the pump servo system. The LM629 receives instructions from the CPU concerning filter coefficients and trajectory and error handling. It processes this information and the encoder feedback (PID algorithm) and creates a PWM signal and a direction signal for loop control. The LM629 then provides the CPU with data regarding the actual motion status and fault conditions.

The encoder signals are buffered before they are processed by LM629. The output PWM and direction data signals are optically isolated to eliminate any ground noise.

LM621

LM621 is a brushless motor commutator chip. This I.C. provides the correct ON-OFF sequencing for the MOSFET drivers by processing the isolated direction signal along with the Hall Effect position signals obtained from the brushless motor.

TC4469

This is a TTL to MOS level translator which accepts the isolated PWM signal and provides the required drive to the "lower" (N-channel) MOSFET.

MPM3003

This is the power stage I.C. which contains three P-channel and three N-channel MOSFETS arranged in a 3-Phase Bridge Topology. These outputs are routed to the phase windings of the pump motor.

Temperature Limit

A temperature limit is established using an LM235, a temperature I.C. sensor which is placed in thermal contact with the MPM3003's heatsink. Its output is compared to a voltage level which represents approximately 90°C. An OVERTEMP flag is indicated if the heatsink's temperature exceeds this level. The OVERTEMP signal turns off the pump relay.

The Controller and Temperature Fault Status for all pump channels is available to the CPU through Port 310h.

Safety Card Monitor

The safety card independently monitors the encoder feedback signals to sense inappropriate motor movement or direction and to track extracorporeal volume (ECV) limits.

Smart Card

The Smart Card module consists of a black anodized frame that serves as a mounting for the Smart Card PCB, card connector, and door position switch. This frame has mounting holes to secure the assembly to the right side of the cabinet chassis.

The frame provides guidance of the smart card into the connector slot and a button to the left of the slot provides ejection of the cards. The module is drip proof when the door is closed. The card will only function if the card is in the connector and the door is closed.

Physical Description

Size = 4 3/4" wide by 1 3/4" high by 4 3/16" deep.

Weight = 6.5 oz.

Power = + 5V < 50 mA

Cards supported by Card Interface

Type I (3.3 mm) and Type II (5.0 mm) per PCMCIA 2.0/JEDIA 4.1 up to 1M byte size.

Firmware support

Interrupts: One for both door and card detect. (distinguished by I/O port bit on CPU.)

Vacuum System (Note: for vacuum centrifuge only)

The vacuum system is used to secure the bowl to the centrifuge spindle. The system consists of the following:

Vacuum Pump which generates approximately -10 to -13.5 psi. The vacuum pump circuit is enabled by the CPU when the bowl optic system detects an empty bowl placed on the centrifuge chuck.

Vacuum Threshold Switch which closes when -9 +/- 1 psi is generated in the vacuum system. This indicates that the bowl is securely seated on the centrifuge chuck.

Electrical Dump which releases the vacuum from the system when the bowl needs to be removed from the centrifuge.

Manual Pressure Bleed Valve, used to manually relieve the vacuum from the system.

Air Filter (replaceable) which prevents airborne contaminants from entering the vacuum system from the centrifuge. The centrifuge chuck contains a hydrophobic filter which prevents fluid from entering the vacuum system. If fluid does manage to enter, the system is designed to evacuate any fluid to the centrifuge spill containment system by pumping it through the vacuum pump.

Circuit Description

Power to the centrifuge vacuum pump is controlled by writing commands from the CPU on the Advanced Motor Driver PCB, which controls a current sink IC. Whenever the output of the current sink is low, +24 VDC is applied to the vacuum pump motor.

Control of the vacuum pump is done by writing the “on” or “off” command to the address 348H BiMOS quad high voltage, high current latched driver. This pump requires 24 VDC at 150 mA to run. D4 (3.9v zener diode) is used to bring the supply voltage of 28 VDC to this level. A voltage drop across the zener provides an indication of the vacuum pump state, which is available to the CPU at U11 (address 344H).

Power to the dump valve is controlled by writing commands to the Advanced Valve Driver PCB, which controls a current sink IC. Whenever the output of the current sink is low, +24 VDC is applied to the dump valve solenoid.

Control of the dump valve is done by writing the “on” or “off” command to the U16 (address 348H) BiMOS quad high voltage, high current latch driver. This valve requires 24 VDC at 20 mA to operate. 220 ohm resistor (RN9C) is used to bring the supply voltage into range. A voltage drop across this resistor provides the dump valve with current information at U11 (address 344H).

The vacuum threshold switch signal is optically isolated on the Advanced Processor PCB and pulled up to +5 VDC before being connected to an I/O port.

Weigher

The weigher is a load cell device which is used to measure the plasma and red cells bag weight. The weigher arm can support up to 2,000 grams of weight. It also provides over stress protection and rotates to store easily under the cover. The load cell is a 15 lb. cell.

The weigher signal is used to calculate the actual volume collected in the plasma bag. This is used to determine the plasma volume to be used in the Return mix protocol, or for collection purposes.

Circuit Description

The load cell bridge uses a +10 VDC excitation voltage to produce two feedback signals of about +5 VDC with respect to ground. When the weigher is loaded, the variance between the two signals ranges from 0 to 30 mV. The two signals are connected to an instrumentation amp bridge circuit. The output is filtered and the signal is then DE multiplexed, sampled, and connected to the A/D converter.

Data Acquisition Card

The Data Card is an optional device of MCS+ eight valve device. It consists of a combination of Hardware and Software that allows to transfer serial data in a safe manner according to medical device standards, in and out of the units, from and to a peripheral.

The Data Card monitors software commands sent out by the unit in serial, to command the board functionality such as switching between barcode scanner and RS232 port, peripheral power supply selection, disable of data transmission.

The Data Card is compatible with earlier released software protocol revisions supporting data transmission. The HaemoData is an optional device that allows printing MCS+ procedure data to a printer.

The various components of the system are the following:

The Datacard (86198-01) is mounted to the inside of the MCS+ rear panel and has one external RS232 port, accessible on the back of the MCS+ device:

The Data port (DB9) dedicated to a RS232 connection includes a DC power supply pin.

CS5 CPU interface

The Datacard (86198-01) is connected to the CS5 CPU through the RS232 port (P103 of the CPU board).

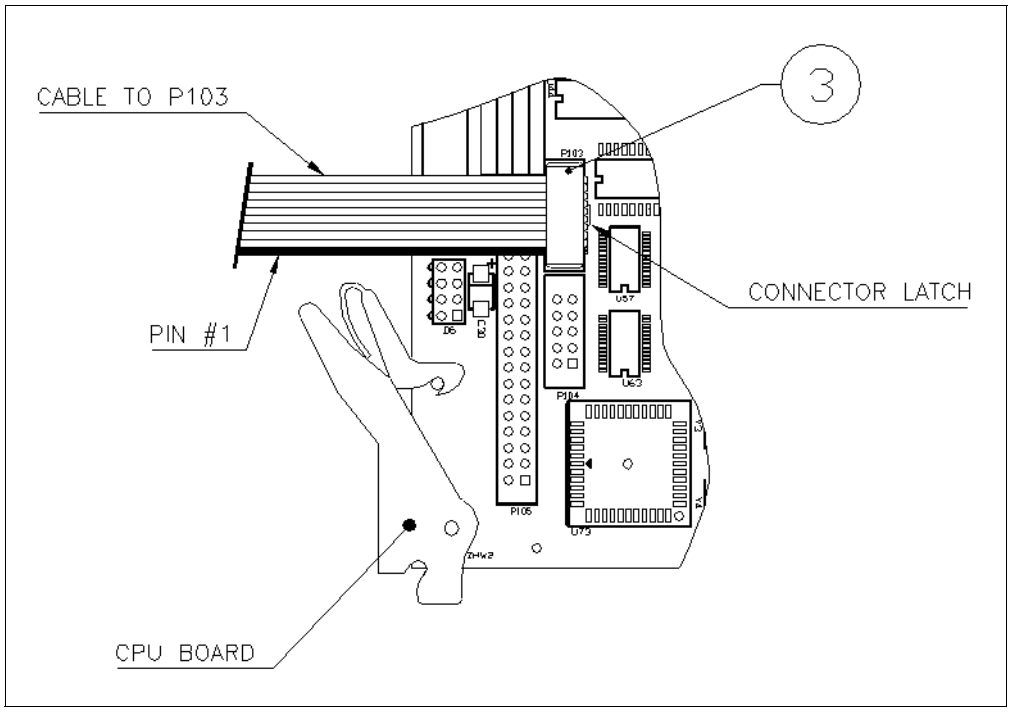


Figure 2-3, Datacard connection

General Features

– 2 wires (RX, TX) RS232 optical isolation (4000 Vrms).
– Isolated (4000 Vrms) single voltage supply (+28VDC).
– Variable transmission speed setting (2400 Bps to 115200 Bps).
– 1 COM port switch to 2 COM ports.
– 2 outputs power supply pins, switch able ON or OFF:
– SP1_SUPPLY for external devices (+5 to +12VDC selectable 1VDC steps).
– SP2_SUPPLY for barcode scanner supply (+5VDC fixed).
– Serial transmission ON and OFF command.
– Hardware and/or software features command.

EMC compliance

The PCB assembly is compliant to IEC 60601-1-2 standard:

Emission:

- RF emissions according to CISPR11 Group 1 Class B.
- Harmonic emissions according to IEC 61000-3-2 Class A.
- Voltage fluctuation/flicker emissions according to IEC61000-3-3.

Immunity:

- Electrostatic discharge (ESD) according to IEC 61000-4-2.
- Electrical fast transient burst according to IEC 61000-4-4.
- Surge according to IEC 61000-4-5.
- Voltage dips, short interruptions and variation on power supply input lines according to IEC 61000-4-11.
- Power frequency (50/60Hz) magnetic field according to IEC61000-4-8.

Applies when:

- PCB assembly is installed on a complete rear panel assembly.
- Rear panel assembly is installed in applicable machine.
- Machine is running with data transfer.

Voltage and Current Requirements Range

Power supply input

Nominal value: +28 VDC 1,3A

Minimum value: +20 VDC 1,8A

Maximum value: +35 VDC 1,0A

All value @ full charge (SP2_SUPPLY = ON and SP1_SUPPLY = 2A @ 12V)

Grounds

Machine digital ground: SYSGND

External digital/analog ground: GND

Power supply output

Maximum value:

SP1_SUPPLY (P1002 pin9): +5 to +12 VDC ±0.5 selectable in 1 VDC steps, 2 A.

SP2_SUPPLY (P1003 pin7): +5VDC ±0.2, 1A.

Isolation

Creepage distance

The creepage distance between primary and secondary circuit of the printed circuit board is 9 mm.

Air clearance

The air clearance between primary and secondary circuit of the printed circuit board is identical to the creepage distance, in this case, and equal to 9mm.

In-Out Withstand Voltage

- Opto coupler HCNW137 (U3)5000 Vrms*
- Opto coupler HCNW135 (U5)5000 Vrms*
- Transformer 78250MV (T1)4000 Vrms
- DC/DC TC2-2415/4 30W (U13)4000 Vrms

Communication

Baud rate

The Data Card works with different baud rate speeds that are set by hardware switch SW1;

2400 Bps, 4800 Bps, 9600 Bps, 19200 Bps, 38400 Bps, 57600 Bps and 115200 Bps.

The default speed rate is 19200 Bps.

Setting

The Data card is working only with the following setting:

Number of data bits is 8.

Parity is none.

Number of stop bit is 1.

Flow control is none.

Data Card Schematic

The functional Data Card bloc diagram is the following:

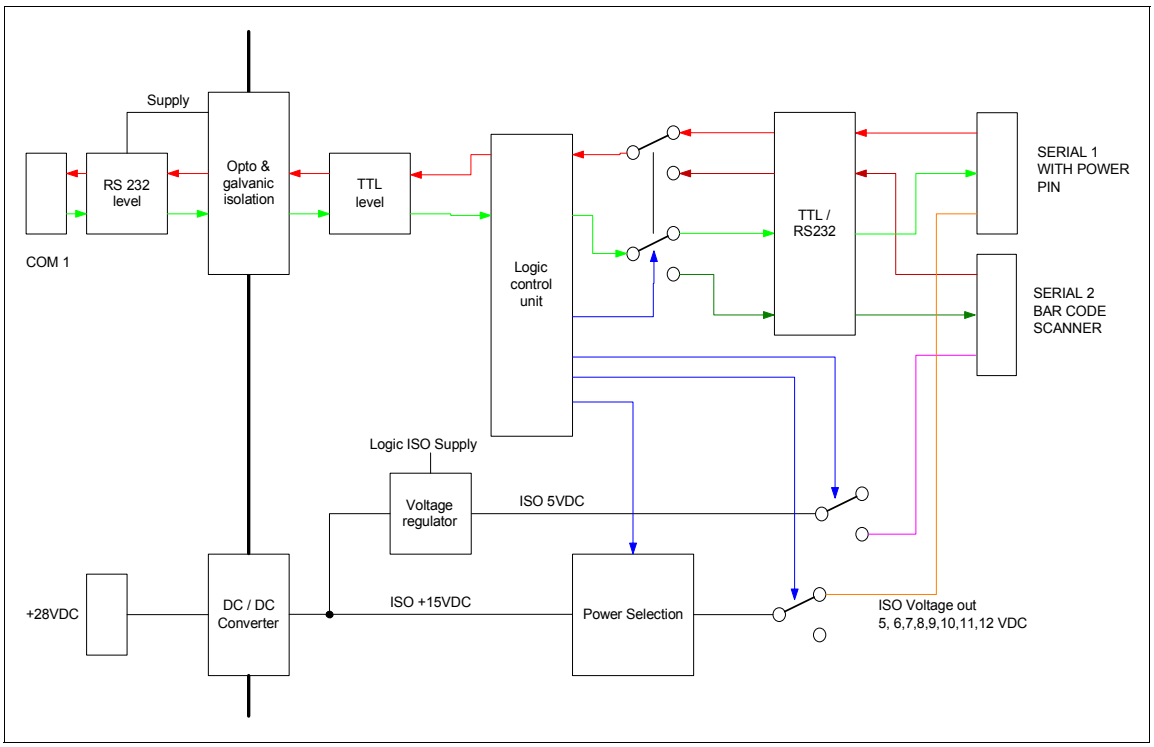


Figure 2-4, Data card schematic

The Data Card has 2 separates circuits, Primary Sector (machine inner side) and Secondary Sector (machine outer side, although this sector is located inside the unit).

The Primary Sector is directly electrically connected to the machine by 2 wires RS232 port (data card COM1) and the machine +28V power supply.

The Secondary Sector is directly electrically connected to the machine outer side by 2 serial ports that are passing through the machine rear panel. The serial 1 and 2 ports allow also supplying power to external devices, such as a barcode scanner, a printer, a wireless RF device

Both circuits are connected to the Primary via optical isolation for RS232 data and transformer isolation for power supplies.

Connectors

P1000: Data Card Power Supply, Primary Sector.

	Signal Name
Pin 1	SYSGND
Pin 2	No Connection
Pin 3	+28 VDC

P1001 & P1001A: Data Card Serial COM Port 1 (COM1), Primary Sector.

These connectors allow to a serial data connection at RS232 level (± 3 to ±14 VDC) between the Unit and the Data Card. These connectors are considered as a DCE (Data Communication Equipment).

	Signal Name	**Comment**
Pin 1	No Connection	
Pin 2	No Connection	
Pin 3	I_SP1_TX	Data leaving the data card **to** the unit (TX)
Pin 4	No Connection	
Pin 5	I_SP1_RX	Data arriving to the data card **from** the unit (RX)
Pin 6	REQ_TO_SEND	Can be shorted with Pin 7 via P1004
Pin 7	DTE_RDY	Can be shorted with Pin 6 via P1004
Pin 8	No Connection	
Pin 9	SYSGND	Unit ground reference
Pin 10	No Connection	

Connector P1001A is a mirror connector of P1001 that allows connecting the data card COM1 port from another PCB edge to the unit.

P1002: Data Card Serial Port 1 (with power supply pin), Secondary Sector.

This connector allows connecting the Data Card to an external peripheral device at an RS232 level (± 3 to ±14 VDC) and also to power this device in a range of 5 to 12 VDC.

This connector is considered as a DTE (Data Terminal Equipment).

	Signal Name	**Comment**
Pin 1	No Connection	
Pin 2	DATA_FROM_SP1	Data arriving to the data card **from** the external device (RX)
Pin 3	DATA_TO_SP1	Data arriving to the data card **to** the external device (TX)
Pin 4	No Connection	
Pin 5	GND	Unit isolated ground reference
Pin 6	No Connection	
Pin 7	No Connection	
Pin 8	No Connection	
Pin 9	SP1_SUPPLY	External device supply 5 to 12 VDC/2A

P1003: Data Card Serial Port 2 (with power supply pin), Secondary Sector.

This connector allows connecting the Data Card to an external peripheral device at an RS232 level (± 3 to ±14 VDC) and also to power this device at a voltage of 5 VDC.

This connector is considered as a DTE (Data Terminal Equipment).

	Signal Name	**Comment**
Pin 1	No Connection	
Pin 2	No Connection	
Pin 3	DATA_FROM_SP2	Data arriving to the data card **from** the external device (RX)
Pin 4	No Connection	
Pin 5	GND	Unit isolated ground reference
Pin 6	DATA_TO_SP2	Data leaving the data card to the external device (TX)
Pin 7	SP2_SUPPLY	External device supply 5 VDC/1A
Pin 8	No Connection	

P1004: Data Card DTE Ready Jumper header.

This jumper header allows shorting the DTE_READY and REQUEST_TO_SEND signals together by a placing a jumper on it. This will activate the TX communication without any handshake when using an 8256 MUART, like it is done on the MCS+ CPU PCB.

	Signal Name
Pin 1	DTE_RDY
Pin 2	REQ_TO_SEND

P1005: Data Card Barcode Mode Echo Jumper header. (Not used in Cell Saver application).

This jumper header allows shorting the 3rd analog switch common signal (U8, pin 13) and TO_NET signals together by a placing a jumper on it. This will allow Haemonet to detect that the Data Card is in barcode mode (refer to DATA ACQUISITION Communication Protocol Description document [4]).

	Signal Name
Pin 1	Analog Switch #3 common
Pin 2	TO_NET

Function Modes

Baud rate setting SW1

	SW1-1	**SW1-2**	**SW1-3**	**SW1-4**
2400 Bps	OFF	OFF	OFF	ON
4800 Bps	OFF	ON	ON	OFF
9600 Bps	OFF	OFF	ON	OFF
19200 Bps	ON	ON	OFF	OFF
38400	OFF	ON	OFF	OFF
57600	ON	OFF	OFF	OFF
115200 Bps	OFF	OFF	OFF	OFF

Mode setting SW2

SW2 – 1 switch position is setting the data card commands in hardware or software mode.

Output voltage configuration (Hardware)

SW2–2 to SW2-5 are acting on P1002 (pin 9) voltage output value from +5 to +12V and switch it on pin 9 ON or OFF.

	SW2-1	**SW2-2**	**SW2-3**	**SW2-4**	**SW2-5**	**SW2-6**
P1002 pin9 = 0 VDC	OFF	OFF				
P1002 pin9 = 5 VDC	OFF	ON	ON	ON	ON	
P1002 pin9 = 6 VDC	OFF	ON	OFF	ON	ON	
P1002 pin9 = 7 VDC	OFF	ON	ON	OFF	ON	
P1002 pin9 = 8 VDC	OFF	ON	OFF	OFF	ON	
P1002 pin9 = 9 VDC	OFF	ON	ON	ON	OFF	
P1002 pin9 = 10 VDC	OFF	ON	OFF	ON	OFF	
P1002 pin9 = 11 VDC	OFF	ON	ON	OFF	OFF	
P1002 pin9 = 12 VDC	OFF	ON	OFF	OFF	OFF	

Output voltage configuration (Software)

The voltage on P1002 (pin9) is monitored by software command.

At Data Card power ON the voltage on P1002 (pin9) is disabled unless the command to switch it on is not send. Unless a voltage value is set through a software command the default value set by SW2–3 to SW2–5 is taken into account.

	Software command	**SW2-1**	**SW2-2**	**SW2-3**	**SW2-4**	**SW2-5**	**SW2-6**
P1002 pin9 = X VDC	"CTRL O," "P"	ON		X	X	X	
P1002 pin9 = 5 VDC	"CTRL O," "5"	ON					
P1002 pin9 = 6 VDC	"CTRL O," "6"	ON					
P1002 pin9 = 7 VDC	"CTRL O," "7"	ON					
P1002 pin9 = 8 VDC	"CTRL O," "8"	ON					
P1002 pin9 = 9 VDC	"CTRL O," "9"	ON					
P1002 pin9 = 10 VDC	"CTRL O," "0"	ON					
P1002 pin9 = 11 VDC	"CTRL O," "1"	ON					
P1002 pin9 = 12 VDC	"CTRL O," "2"	ON					
P1002 pin9 = 0 VDC	"CTRL O," "D"						

Cable assembly, Ribbon, Internal RS232

Part Number: 86233-00

Cable assembly, DataCard power CS5

Part number: 86242-00

Chapter 3
Principles of Operation

This chapter provides detailed information on the MCS+ user interface, the operation of the MCS+ from power on to protocol execution, system diagnostics, process monitoring, the Perpetual System Monitor, machine parameters, error history, the cycle program, and MCS+ Utilities.

User Interface

This section provides detailed information on the MCS+ user interface including the key panel, how information is displayed to the operator, icons, alarms, Help, the HaemoCalculator, and Modify.

Key Panel

The panel is color coded for enhanced visibility and function grouping. Each time a key is pressed, the MCS+ emits a short beep to confirm recognition of a keypress.

Figure 3-1, MCS+ Key Panel

Table 3-1 shows the MCS+ keys and their function.

Table 3-1: Keys

Key	Function
PRIME	Initiates the prime sequence following the disposable installation
DRAW	Starts the Draw cycle
RETURN	Starts the Return cycle (manually)
STOP	Stops the pumps and the centrifuge, closes the applicable pinch valves, and switches the MCS+ to the Ready mode
MODIFY	Allows modification of collection parameters before and during a procedure without interrupting the procedure
SAVE	Saves the parameter being modified in non-volatile memory which retains the parameter information when the MCS+ is turned off. **Note: This key is only used in the Modify mode.**
YES (+) / NO (-)	Allows the operator to increase or decrease the parameter values and to answer questions in the Modify mode. To change numerical values, hold down either key until reaching the correct value.
PUMP START/STOP	Starts or stops all the MCS+ pumps.
PUMP ↓ & ↑	Increases or decreases the pump speed during Draw or Return. To change the speed, hold down either key until reaching the appropriate speed.
CUFF	Inflates or deflates the cuff. Pressing CUFF pressurizes the cuff to the programmed value.
HELP/HaemoCalculator	Initiates the HaemoCalculator and displays process information. **Note: In WARNING situations, press this key to get help information.**

Display Organization

The display is 320x128 pixels and is used to show all relevant machine parameters and to interact with the operator. Large font characters are 20 pixels high and 16 pixels wide. Small font characters are 7 pixels high and 6 pixels wide.

During the Ready, Draw and Return states of the machine, the screen information is organized as shown on the following page.

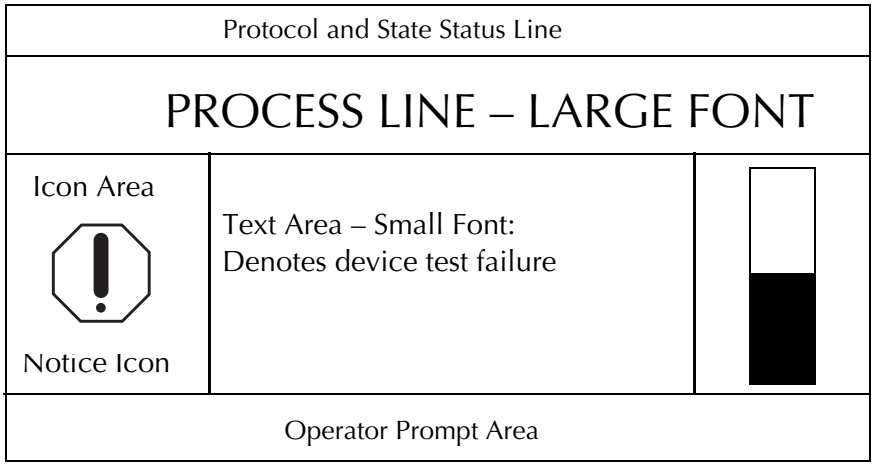


Table 3-2 describes each section of the screen display.

Table 3-2: MCS+ Screen Display

Display Area	Provides:
Protocol and State Status Line	Protocol and state status information in small text. This line is at the top of the screen and is separated from the lower parts by a line. Information on this line is present during all operations. Constantly updated numeric information as to cycle number, volume processed, and time left in procedure.
Process Line	Information on Draw, Return, and Ready, as well as the pump speed. This line is located in the center of the display.
Icon Area	Graphical representation of the present machine mode.
Donor Flow Status	A bar graph representing the donor flow status. Pressure is at a maximum when the bar reaches the top, and at a minimum when the bar is at the bottom. The bar graph has different scales in Draw and Return: **Min.** **Max.** Draw cycle -50 +50 Return Cycle 0 +260

Icons

For different states of the MCS+, an icon is displayed to graphically describe the operation. Table 3-3 shows each MCS+ icon and its indication.

Table 3-3: MCS+ Icons

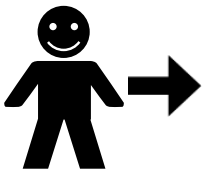
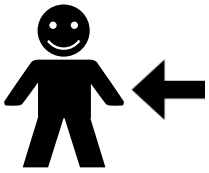
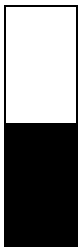
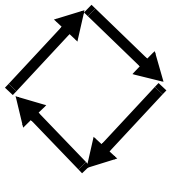
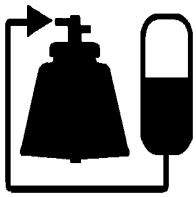
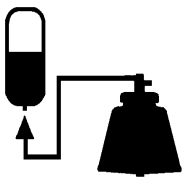
	Indicates machine mode where fluids are not being drawn or returned to the patient/donor.
	Indicates that fluids are being drawn from the patient/donor.
	Indicates that fluids are being returned to the patient/donor.
	Indicates flow sensed by the Donor Pressure Monitor (DPM) when fluids are being drawn from the patient/donor and back pressure sensed by the Donor Pressure Monitor (DPM) when fluids are being returned to the patient/donor.
	Indicates that a notice and/or warning message is displayed on the screen.
	Indicates that the collection disposable is being primed.

Table 3-3: MCS+ Icons (Continued)

	Indicates machine substate SURGE when component collection takes place.
	Indicates Plasma Transfer or Dwell state when fluid is transferred from a bag to the bowl, usually during the Return state.
	Indicates Bowl Transfer state when blood components are transferred from the bowl to a bag, usually during the Return state.

Alarms

Table 3-4 describes the type of audible alarms used in the MCS+.

Table 3-4: MCS+ Alarms

Type of Alarm	Meaning/Sound/Muting Action
Confirmation	At specific points during installation and operation, the MCS+ provides a one-time unique sound to signify the recognition of some action by the operator.
Warning	Notifies the operator of a situation needing attention or corrective action. The unique audible is repeated until the action is performed. The operator can MUTE the sound for 30 seconds by pressing the NO(-) key.
Critical Error	Notifies the operator of a procedure failure. The unique audible is repeated until the action is performed. The operator can MUTE the sound for 30 seconds by pressing the NO(-) key.
Procedure Complete	Alerts the operator that a procedure has completed by emitting 5 short beeps at 1/4 second intervals.

During WARNING situations, a warning is shown in large text in the main screen. The operator is prompted to press the HELP key to get additional information and instructions.

The following shows an example of an alarm display message:

SDP	DRAW	Filling Bowl
PUMP PROBLEM BLOOD PUMP WAS TURNING TOO SLOW.		
Press NO to Mute the Alarm. Press HELP for More Information. Press DRAW to Continue.		

The following shows the type of display when the operator presses HELP:

SDP	DRAW	Filling Bowl
BLOOD PUMP WAS TURNING TOO SLOW. A restriction may have occurred. 1. Check pump for restrictions. 2. Check pump for kinked tubing. 3. Resume operation.		
Press NO to Mute the Alarm. Press HELP for More Information. Press DRAW to Continue.		

Help

During normal collection conditions in the Draw, Return or Ready mode, additional information can be brought to the display by pressing the HELP key.

Pressing the PUMP UP, PUMP DOWN or PUMP START/STOP keys causes the screen to return to the main display. Pressing STOP causes the system to enter the stop mode with a ready screen displayed.

HaemoUpdate

The first press of the HELP key displays process parameters maintained by the MCS+, as shown below.

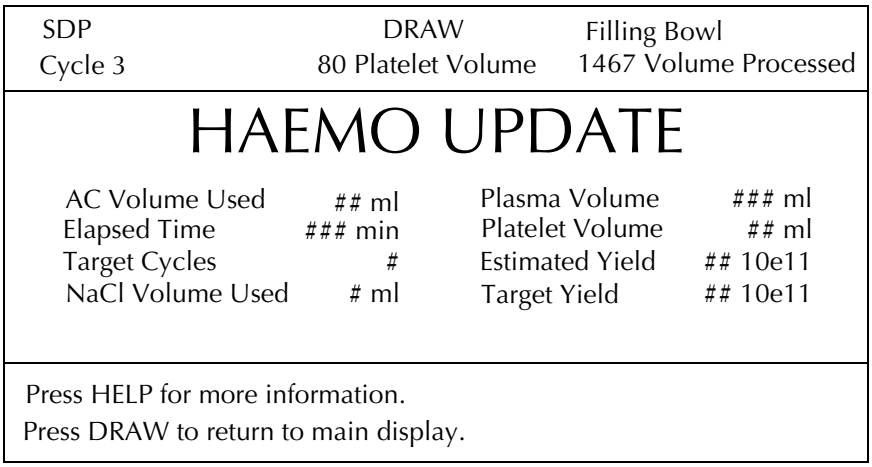


Figure 3-1, Sample Haemo Update screen

The following screen shows an example of the HaemoUpdate during an alarm condition .

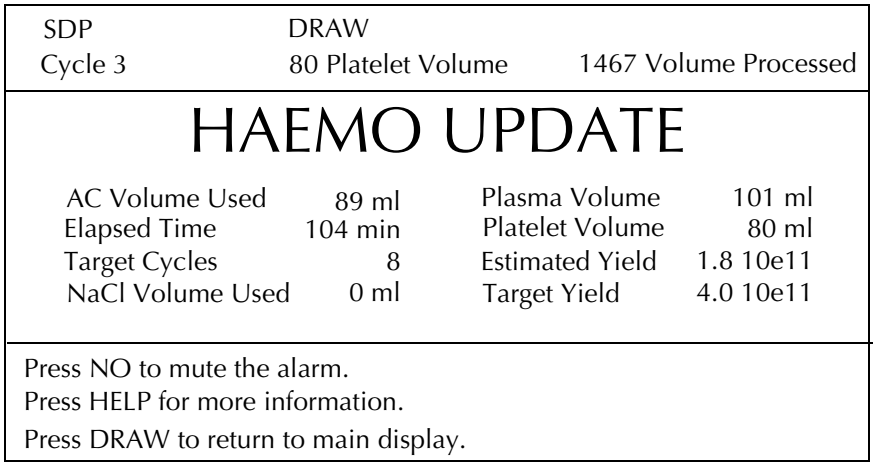


Figure 3-2, Sample Haemo Update screen alarm state

HaemoCalculator

The HaemoCalculator screen is used to enter and view donor parameters and calculated processing targets. To begin a Platelet protocol, donor values must be input. These values may be changed during the procedure. The MCS+ adjusts its targets each time these values are changed.

To enter the HaemoCalculator, press the HELP key twice. While in the calculator mode, the field to be modified is highlighted. The value may be changed by pressing the +/- keys. Fields are advanced by pressing the MODIFY key. Field selection wraps around to the top left after the last field on the lower right

Each time a field is advanced, a new calculation is performed and the results are displayed in affected fields.

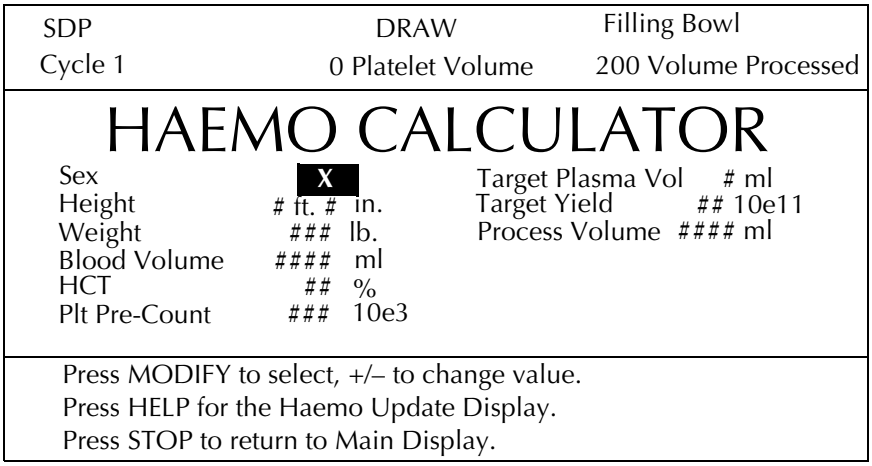


Figure 3-3, Sample Haemo Calculator screen

Press the HELP key to move from the HaemoCalculator mode to the Update screen. To exit this mode, press DRAW, RETURN, or STOP.

Pressing the PUMP UP, PUMP DOWN or PUMP STOP keys returns to the main display. Pressing STOP causes the system to enter the stop mode and displays a ready screen.

Modify

The Modify mode allows the operator to change various machine parameters both temporarily and/or permanently. This mode can be entered in the Ready mode or during the Draw and Return cycles.

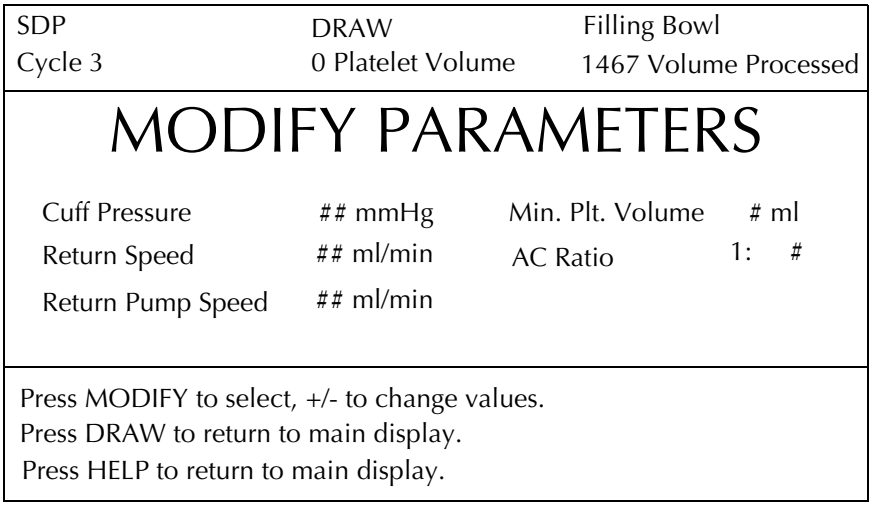


Figure 3-4, Sample Modify Parameters screen

During Modify, the SAVE, YES, NO, STOP, RETURN, DRAW, START/STOP, PUMP UP, PUMP DOWN and CUFF keys are active.

Repeated key presses of the MODIFY key toggle between the different variables. When the last variable is reached, press MODIFY again to return the MCS+ to the first item in the menu.

To change numeric values for the different parameters, hold down the YES key to increment the active value. When the key is released, the incrementing stops. The NO key functions in a similar fashion.

The SAVE key is used to permanently store the active parameter. This is primarily done if the operator prefers a value different than the current default. If SAVE is not pressed, the default values are reset the next time the MCS+ is powered on.

In the Ready mode, for example, the Cuff Pressure can be changed to a value other than the default of 50. To do this, press MODIFY to display the first variable, Cuff Pressure. Press the YES or NO keys to increase or decrease the value. To save this value, press the SAVE key.

While in the Modify parameters mode, any NOTICE condition causes the screen to go to the NOTICE state. If the Pump up/down keys are pressed, the screen returns to the main display for pump speed incrementing. If the START/STOP key is pressed, the screen returns to the main display and stops the pumps. Pressing STOP will cause the system to enter the stop mode with a ready screen displayed.

Press HELP to return to the main display.

MCS+ Power On Sequence

This section describes the operation of the MCS+ from power on to protocol execution. At power-on, the system performs a series of diagnostic tests to ensure proper operation. Figure 3-5 shows the MCS+ power on sequence.

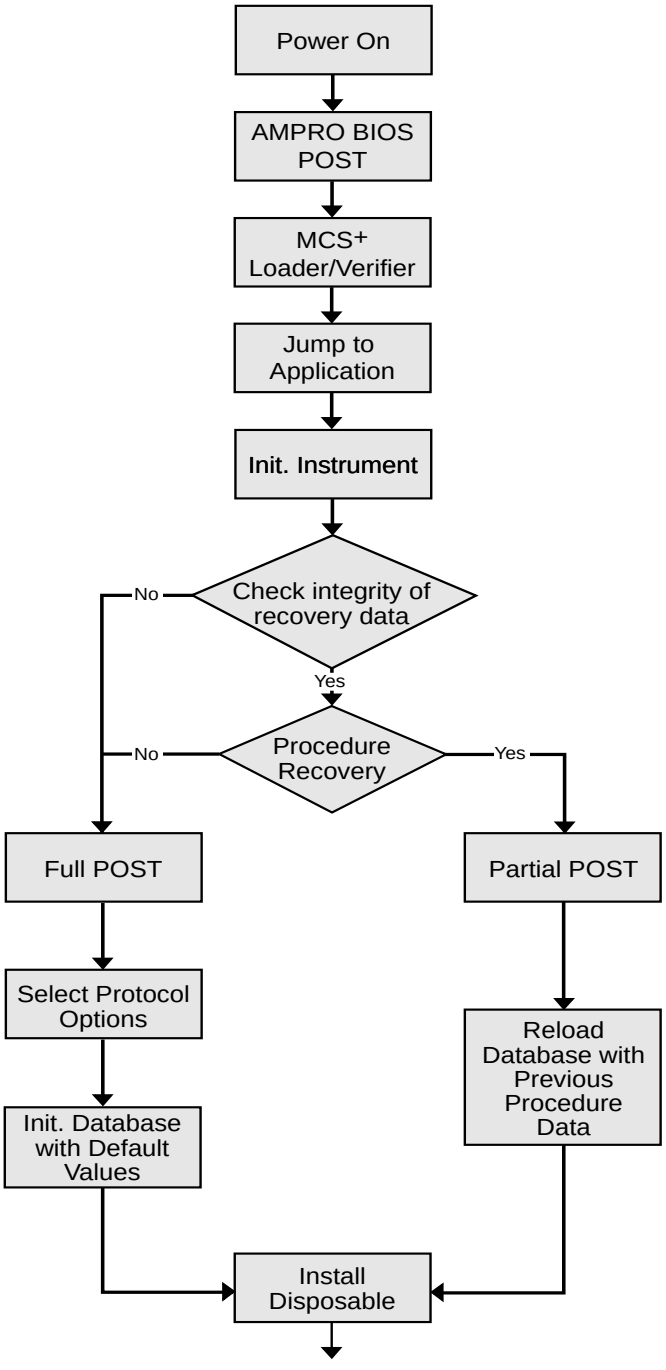


Figure 3-5, Power-On Sequence

Power-On Self-Tests (POST)

The following section describes each of the devices tested and the associated error code in case of failure. In the event of a test failure, the operator is prompted to press HELP for more information about the error code.

RAM Test

The RAM test is performed when the MCS+ is first powered on (before the MCS+ Systems Tests are displayed on the screen). The MCS+ emits a tone while testing RAM memory. Random key lights are displayed on the front panel of the MCS+. System static RAM is checked for the ability to retain data and to ensure that no bits are "stuck." In the event a "stuck" bit is detected, the RAM testing tone sounds continuously and will not turn off within two seconds as in the case of the system static RAM test passing.

No display is used for the RAM test; only a constant tone is heard if the RAM test fails.

CPU Test

The CPU test is executed after the static RAM test is successfully completed. This test is performed before the MCS+ Systems Tests are displayed on the screen. It tests the functional operation of the CPU's opcodes and makes sure that all opcodes and registers are operating correctly. In the event the CPU test fails, a CPU failure message is reported along with **Error Code 400**.

Protocol Card Detection

The detection of an inserted protocol card is done by reading an I/O mapped port connected to the protocol card's socket. When the card is inserted, it connects the I/O mapped card detection port to ground. This indicates that the card is installed. When the card is not installed, the I/O mapped card detection port is pulled up high to indicate that a protocol card is not installed. The system displays a message informing the operator to insert a protocol card.

A CRC check is performed on the entire contents of the card and compared to a value stored in the last two bytes of the highest address space. If the numbers do not match, a warning is issued and processing is halted. The system displays the **Error Code 404**.

ROM CRC Test

A CRC 16 (Cyclic Redundancy Check, CCITT) is computed from the program code and compared with a value stored in the program chip. While the ROM CRC Test is being performed, a bar graph is displayed on the screen indicating testing progress. In the event the ROM test fails, a text error message is displayed indicating the type of test that failed and the system issues an audible warning. The system displays the **Error Code 402**. The operator is prompted to press the HELP key on the front panel of the MCS+ for a more detailed explanation of the error.

Once the test passes, the ROM CRC value is then checked against the ROM CRC value stored in NVRAM. If the values do not match, it indicates that the program chip or the NVRAM chip has been changed. This causes the stored protocol and recovery data to be reset to their default/initial values.

Screen Test

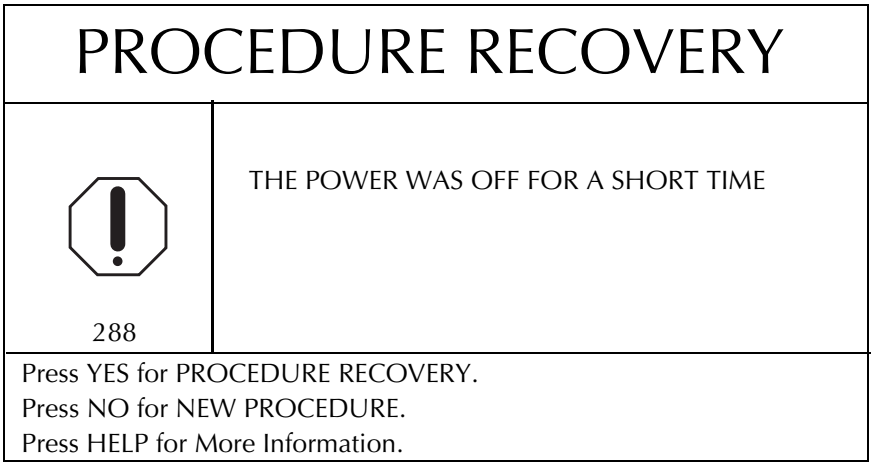
The MCS+ performs a screen test by first turning on all the display pixels, then turning them off. This test is performed before the MCS+ POST Tests are displayed on the screen.

No failure message is displayed for the screen test. The operator is required to visually inspect the display during this test and determine if it is displaying correctly.

Protocol Display

Once the overall PC card CRC check is successfully completed, card information is read from the attribute memory area and all protocols stored on the card are read and displayed for the operator. If the desired protocol is not on the list of displayed protocols, the operator should turn the power off and insert another protocol card.

Procedure Recovery


PROCEDURE RECOVERY
THE POWER WAS OFF FOR A SHORT TIME
288
Press YES for PROCEDURE RECOVERY.
Press NO for NEW PROCEDURE.
Press HELP for More Information.

The MCS+ recovery procedure provides the ability to restore the MCS+ from a shutdown state. In the event the MCS+ either shuts down by itself or the unit is switched off during a procedure, recovery data is available for restarting the MCS+ and either continuing with a procedure or restarting the MCS+ for a new procedure. Recovery data is available if the MCS+ is powered back on within 30 minutes of the power off event, and if Prime was successfully completed the last time the MCS+ was powered on.

During the operation of a procedure, system data (volume processed, AC used, platelets collected, and system offsets for the weigher, cuff, SPM, and DPM) are saved every five seconds and stored to NVRAM. The system data is stored in two copies. The first copy is the most recent system sample. The second copy is one sample period behind the first copy. Both copies of recovery data have their CRC16 stored along with the data each time the system data is sampled.

The recovery data is stored twice in the event the system should shut down or be powered off during the update of recovery data in NVRAM. When the MCS+ is powered back up after a system is shut down before a procedure is completed, recovery data copies #1 and #2 are checked to make sure that their CRC16 matches the data stored. Recovery data copy #1 is tested first. If its CRC16 does not match its data then copy #1 is considered to be bad. Copy #2's recovery data is then checked (using it as a backup) to make sure that its CRC16 matches the data stored in NVRAM. In the event that recovery data copy #2 is also bad, a message is displayed to the operator that NO RECOVERY DATA AVAILABLE. The operator is forced to start the procedure from the beginning. This forces all system variables to reset.

When a good copy of data is found (copy #1 or copy #2) a message is displayed to the operator to either press the YES button to restore the previous procedure or the NO button to restart and reinitialize the MCS+ for a new procedure. If the operator selects NO to restore the previous procedure a second recovery confirmation screen is displayed alerting the operator that a procedure recovery is about to begin. A press of the YES key is required to begin procedure recovery; otherwise pressing the NO key will abort procedure recovery and start a new procedure.

The MCS+ recovery procedure screen is displayed on power-up whenever the procedure status flag does not get set to procedure complete. In order for the procedure status flag to get set to procedure complete, a procedure must be completed directly to the unload screen. If the operator elects to restore a previous procedure the system will skip the power-up systems VALVE TEST, disposable installation step, and Prime state. This is needed to prevent blood components in the disposable from contaminating the product. Also, the weigher will not be tared on the first pass through draw since its offset value is already known from the saved recovery data.

Once procedure recovery has been selected the following data is restored:

- All calibration values (Offsets)
- Cycle #
- Total volume processed
- Plasma volume previous cycle
- Total plasma collected
- Total platelets collected
- Total AC used
- Protocol used
- Bowl volume
- All HaemoCalculator values
- All modifiable parameters

If recovery is initiated from an unrecoverable error, it is assumed that the system must be completely reinitialized. It is also assumed that the disposable is loaded and primed. The recovery process is the same under both circumstances and will proceed as shown in the flowchart.

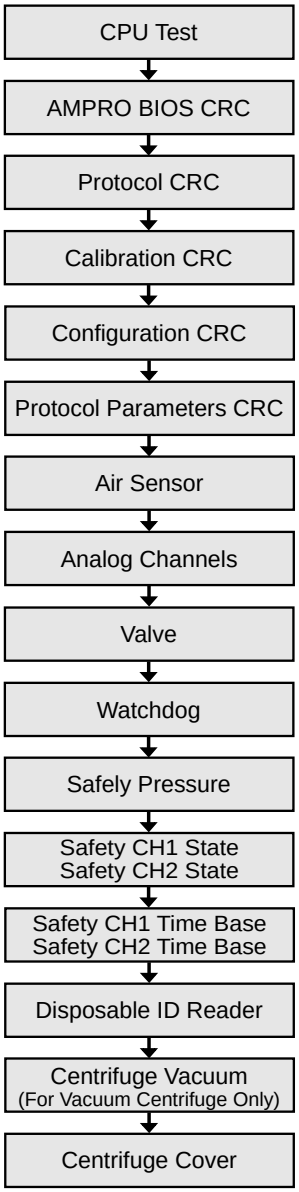
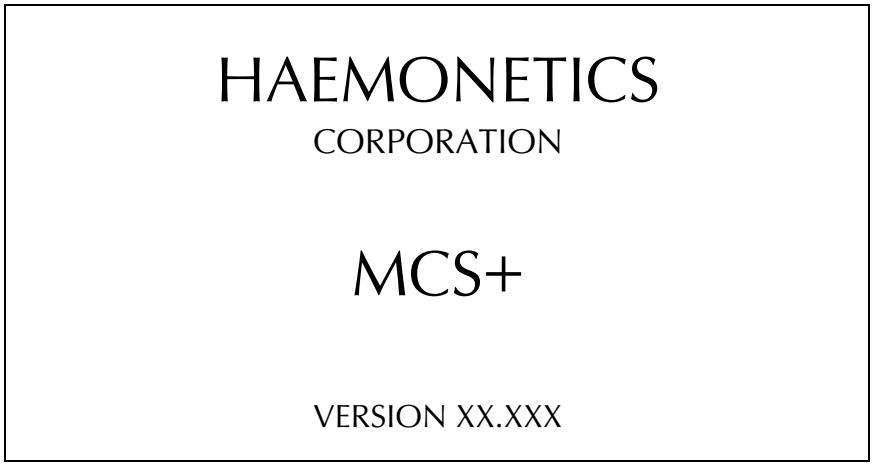


Figure 3-6, MCS+ Power-On Self-Test

System Diagnostics

During the power up self-tests, the display continually updates a bar graph indicating the percentage of tests complete. The update occurs at least once every 2 seconds. In the event that a test fails, the failure is identified and the appropriate message displayed.

Power Up Display



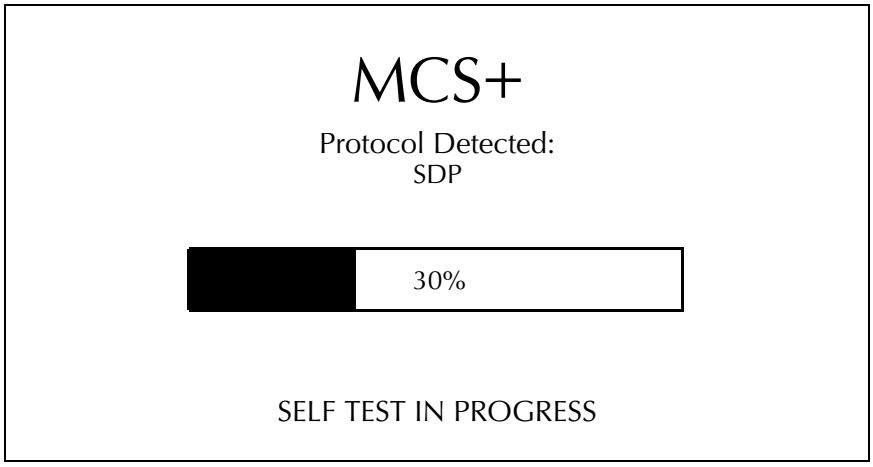


Table 3-5 shows each test (in order) performed during Power On. In the event a test fails, a text error message is displayed indicating the type of test that failed and the system issues an audible warning. In addition, the operator is prompted to press the HELP key for a more detailed explanation of the error. For more detail on each error code, refer to the Trouble-shooting Chapter.

Table 3-5: Power On Self-Tests

Type of Test	Error Code (if test failed)	Text Area Description
Calibration Parameters	405	Calibration CRC Test Failed
Configuration Parameters	406	Configuration CRC Test Failed
Protocol Parameters	471	Protocol Parameters Reset
Air Sensors	408 409 410 411	ACAD Test Failed BLAD Test Failed DLAD1 Test Failed DLAD2 Test Failed
Analog Verification	423 424 427 428 420 421 422	Clamp DPM Line, Remove Filter Clamp SPM Line, Remove Filter DPM Connector Test Failed SPM Connector Test Failed A/D Converter 20% Test Failed A/D Converter 50% Test Failed A/D Converter 80% Test Failed
DPM & SPM Offset	429 430	DPM is Out of Tolerance SPM is Out of Tolerance
Weigher	466 431	Remove Weight from Weigher Weigher is Out of Tolerance
Line Sensor	435 436	Line Sensor Output Too Low Line Sensor Output Too High
Cuff Test	467 432	Disconnect Cuff from Rear Panel Cuff is Out of Tolerance
Valve Transitioning	415 416 417 419 418 414 413	Red Valve Failed Self-Test Blue Valve Failed Self-Test Yellow Valve Failed Self-Test Green Valve Failed Self-Test White Valve Failed Self-Test Orange Valve Failed Self-Test Purple Valve Failed Self-Test
Safety System	433	Safety System Failed Self-Test
Watchdog	438	Watchdog Failed Self-Test
Low Pressure	439	Low Pressure at DPM
High Pressure	441	High Pressure at DPM
CH1 State	443	Channel 1 State Test Failed
CH2 State	444	Channel 2 State Test Failed
CH1 Time Base	447	Channel 1 Time Base Test Failed
CH2 Time Base	448	Channel 2 Time Base Test Failed
Vacuum System	461	Centrifuge Vacuum Sys is Obstructed
Centrifuge Cover	469 470	Open the Centrifuge Cover Latch Close the Centrifuge Cover Latch
Disposable Installation	407	Protocol Card Does Not Match Disp.

Calibration Parameters

A CRC for the machine calibration variables storage space is computed and compared with the expected CRC stored value in non-volatile memory. Both values must match for proper operation. In the event the calibration test fails, a text error message is displayed indicating the type of test that failed and the system issues an audible warning.

Configuration Parameters

The configuration test is performed to test the integrity of variable storage space used for the MCS+ language configuration. In the event the CONFIG test fails, a text error message is displayed indicating the type of test that failed and the system issues an audible warning.

Protocol Parameters

The calculated CRC value of the stored protocol parameters is compared with the stored expected CRC value in non-volatile memory to check the integrity of the protocol parameters.

The operator is then prompted to press the YES key on the front panel of the MCS+ key panel to acknowledge the reset of the parameters. Once the YES key is pressed the system proceeds to the next systems power-up test.

Air Sensors Test

All air detectors are tested for their ability to sense air. In the event an air detector senses fluid, its test line is turned on to ensure that air can be sensed. Operators do not have to remove the tubing from the device.

Analog Verification

The system analog to digital converter is verified by switching known voltages to the device. The resulting values are then tested to make sure that they are within a specified range. The signals used are the DPM and the SPM. For each of these signals, 20%, 50% and 80% of the maximum values are used. Prior to testing the analog signal levels, the DPM and SPM interlocks are tested to makes sure that they are not installed. If either the DPM or SPM filters are installed, the system prompts the operator to remove the detected filter before the analog test can continue. The MCS+ issues a standard alarm if an installed filter is detected. The audible alarm persists until the filter is removed from the system or until the interlock removal time-out has been reached (60 seconds).

DPM and SPM Offset Test

The DPM and SPM transducers on the MCS+ are tested to make sure that when the DPM and SPM filters are not installed, the values read back from the DPM and SPM are within specification. If the values read back from the DPM and SPM are not within ambient pressure levels, a transducer failure is displayed. Prior to testing DPM and SPM levels, the DPM and SPM interlocks are tested to make sure that the DPM and SPM filters are not installed.

If either the DPM or SPM filters are installed, the system prompts the operator to remove the detected filter before the DPM SPM offset test can continue. The audible warning persists until the filter is removed from the system or until the interlock removal time-out has been reached (60 seconds).

Weigher Test

The weigher test reads the weigher to make sure that the weigher data being read is within specification. If ±125 digital units from the standard offset are detected on the weigher, a warning message is displayed prompting the operator to remove all weight from the weigher and the system beeps once per second.

If the weight on the weigher remains for more than 60 seconds, the weigher load cell is considered to be out of tolerance.

Line Sensor

The line sensor is tested for correct voltage levels, assuming no tubing is installed.

When voltage is below 2.75V or above 4.75V, the MCS+ prompts the operator to make sure the line sensor is clean and to check the tubing.

If the operator presses YES, and the voltage is still too low, the MCS+ informs the operator of the situation.

Cuff Test

The cuff test reads the cuff transducer to make sure that the cuff transducer data being read is within specification. If the data is not within specification, a warning message is displayed prompting the operator to remove the cuff from the system and an audible warning is generated.

If the cuff data read remains out of specification for more than 60 seconds, the cuff transducer is considered out of tolerance.

Valve Transitioning

All the valves are transitioned (opened, closed) and their respective position feedback's compared. Multiple valve switching from a single valve command is checked. The current feedback transition for each valve is monitored to make sure that when the valves transition, the current must be seen to transition from low current to high current and back to low current again.

Safety System

The following test sets test the functionality of the safety system board. The safety system is tested for its ability to disconnect power to both pumps (open the safety systems relay) under different simulated error conditions. If either pump is rotated out of position during the safety systems tests, the safety systems test being performed terminates and fails. Two seconds later a text error message is displayed indicating the type of test that failed and the system generates an audible error.

Watchdog Test

The safety system monitors the watchdog clock that is created from the Advanced Processor PCB to keep the safety system synchronized with the CPU. The watchdog is tested by stopping the watchdog clock generated by the CPU and then verifying that the safety system reacts to the simulated fault by opening the safety system relay (located on the Driver PCB), and posting a fault in the safety system's registers. The fault must be detected by both safety system channels for the simulated fault test to pass. The watchdog clock is then restarted by the CPU and resynchronized with the safety board. The CPU then reads the safety system relay and expects it to be closed and the posted safety system fault is cleared from the safety system's fault register.

Low Pressure Test

The safety system monitors the donor pressure monitor transducer (DPM) to make sure that the pressure sensed is within the acceptable specified limits. The low pressure safety system test verifies the safety system's ability to respond to low pressures sensed at the DPM.

A low pressure fault is simulated electrically at the DPM and the safety system is expected to react to the low pressure fault by opening the safety system's relay and posting a low pressure fault in the safety system's registers. The fault must be detected by both safety system channels for the simulated fault test to pass. The DPM pressure data is also read back during the time of the simulated low pressure fault and checked to make sure that the DPM is indeed experiencing a low pressure condition. The low pressure fault is then removed and the safety system is expected to close the safety system relay and remove the posted low pressure fault from the safety system's fault register.

High Pressure Test

The safety system monitors the donor pressure monitor transducer (DPM) to make sure that the pressure sensed is within the acceptable specified limits. The high pressure safety system test tests the safety systems ability to respond to high pressures sensed at the DPM.

A high pressure fault is simulated electrically at the DPM. The safety system is expected to react to the high pressure fault by opening the safety systems relay and posting a high pressure fault in the safety system's registers. The fault must be detected by both safety system channels for the simulated fault test to pass. The DPM pressure data is also read back during the time of the simulated high pressure fault and checked to make sure that the DPM is indeed experiencing a high pressure condition. The high pressure fault is then removed and the safety system is expected to close the safety system relay and remove the posted high pressure fault from the safety system's fault register.

CH1 State Test

The state test tests the ability of the safety system to detect invalid state changes. The state test is performed by issuing a transfer state command to channel 1of the safety system. The safety system is expected to open the safety system relay and post a state fault to channel 1 of the safety system fault register. Next, the fault is removed by commanding the safety system to the safe state. The safety system relay is expected to close and the posted safety system fault is expected to be cleared from channel 1's fault register.

CH2 State Test

The state test tests the ability of the safety system to detect invalid state changes. The state test is performed by issuing a transfer state command to channel 2 of the safety system. The safety system is expected to open the safety system relay and post a state fault to channel 2 of the safety system fault register. Next, the fault is removed by commanding the safety system to the safe state. The safety system relay is expected to close and the posted safety system fault is expected to be cleared from channel 2's fault register.

CH1 Time Base Test

The channel 1 time base test tests the time base generator used by the safety system for calculation of pump ratios, and volume processed. The test is performed by disabling the time base generator by issuing a time base disable command to the safety system board. The safety system must detect the disabled time base generator clock, open the safety system relay, and post a time base fault to channel 1's safety system's fault register. Next, a command is issued to the safety system to re-enable the time base generator. The safety system is expected to close the safety system relay and clear the time base fault from channel 1's safety system fault register.

CH2 Time Base Test

The channel 2 time base test tests the time base generator used by the safety system for calculation of pump ratios, and volume processed. The test is performed by disabling the time base generator by issuing a time base disable command to the safety system board. The safety system must detect the disabled time base generator clock, open the safety system relay, and post a time base fault to channel 2's safety system's fault register. Next, a command is issued to the safety system to re-enable the time base generator. The safety system is expected to close the safety system relay and clear the time base fault from channel 2's safety system fault register.

Vacuum System Test (for vacuum centrifuge only)

Prior to testing the vacuum, the system dump valve is opened to relieve all pressure in the system. The machine first checks the optics level to determine if a bowl is installed. Only if a bowl is not installed is the test performed, otherwise the test is skipped. In testing the vacuum system, the vacuum pump is turned on and after 3 seconds the vacuum switch is checked. If the vacuum switch is closed, it indicates that there is a blockage somewhere in the system and a fault is posted to the safety system's fault register.

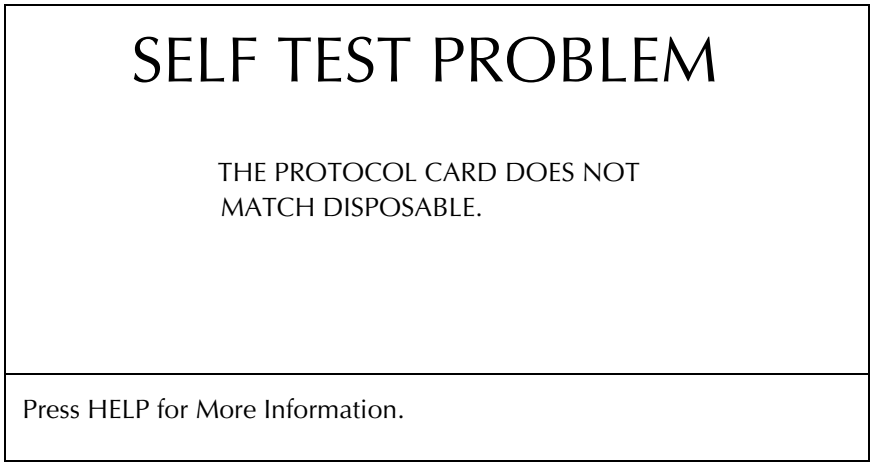
Centrifuge Cover Test

Upon completion of the power-up tests, the MCS+ display is cleared and the centrifuge cover switch test is performed. The centrifuge switch test requires the operator to manually test the centrifuge cover switch and the centrifuge relay transitioning. The centrifuge cover test starts by checking the initial state of the cover switch. If the cover is open, the MCS+ prompts the operator to close the cover, open it and close it again. If the cover is closed, the MCS+ prompts the operator to open the cover, close it, and open it again. In the event of a failure the test will not proceed and will continue to prompt to either open the cover or close the cover.

Disposable Installation

After the MCS+ has been initialized and all power-up testing is completed, the operator is prompted to load the disposable onto the machine. Once the disposable has been sensed by the MCS+ as being completely loaded, the disposable identification number is read twice (to verify its integrity). The CPU then verifies the selected protocol to determine if the disposable ID matches the protocol selected.

In the event that the disposable ID and the protocol identified do not match, the following information is displayed in a Notice message.



Note: **Frame bits between parenthesis (which are always zero) are part of the raw data codes and excluded from the disposable ID Codes.**

Table 3-6: Disposable ID Codes

msb > CODE < lsb	Seven valve device protocol assignment	Eight valve device protocol assignment
(1) 0 0 0 0 0 0 (1)		LDP Fuji Surge
(0) 0 0 0 0 0 0 (0)	SDP,PLP (No Saline) DEFAULT, NO LABEL DATA	LDP DEFAULT BLANK LABEL DATA
(0) 0 0 0 1 1 1 (0)	SDP,PLP (Saline)	PBSC 125ML
(0) 0 0 1 0 1 1 (0)	TPE (125ML LTH,1A)	
(0) 0 0 1 1 0 1 (0)	TPE (250ML LTH,1A)	
(0) 0 0 1 1 1 0 (0)	TPE (125ML LTH,2A)	PBSC 225ML
(0) 0 1 0 0 1 1 (0)	TPE (250ML LTH,2A)	TPE 125ML
(0) 0 1 0 1 0 1 (0)	MNC (125ML LTH,1A)	TPE 225ML
(0) 0 1 0 1 1 0 (0)	MNC (250ML LTH,1A)	
(0) 0 1 1 0 0 1 (0)	MNC (125ML LTH,2A)	
(0) 0 1 1 0 1 0 (0)	MNC (250ML LTH,2A)	
(0) 0 1 1 1 0 0 (0)	FFP (LTH, Saline)	
(0) 1 0 0 0 1 1 (0)	FFP (LTH,NO Saline)	
(0) 1 0 0 1 0 1 (0)	FFP (BM, Saline)	PPP/FFP bmb, FFP Latham, PES2
(0) 1 0 0 1 1 0 (0)	FFP (BM,NO Saline)	LDPRBC, RBCP+, SDR
(0) 1 0 1 0 0 1 (0)	2RBC (Saline)	
(0) 1 0 1 0 1 0 (0)	2RBC (NO Saline)	
(0) 1 0 1 1 0 0 (0)	RBCP (Saline)	TAE
(0) 1 1 0 0 0 1 (0)	RBCP (NO Saline)	
(0) 1 1 0 0 1 0 (0)	AIS FB	BMT
(0) 1 1 0 1 0 0 (0)	APC	
(0) 1 1 1 0 0 0 (0)	SDL	
(1) 1 1 1 1 1 1 (1)	NO MCS+ DISPOSABLE IN PLACE	NO MCS+ DISPOSABLE IN PLACE

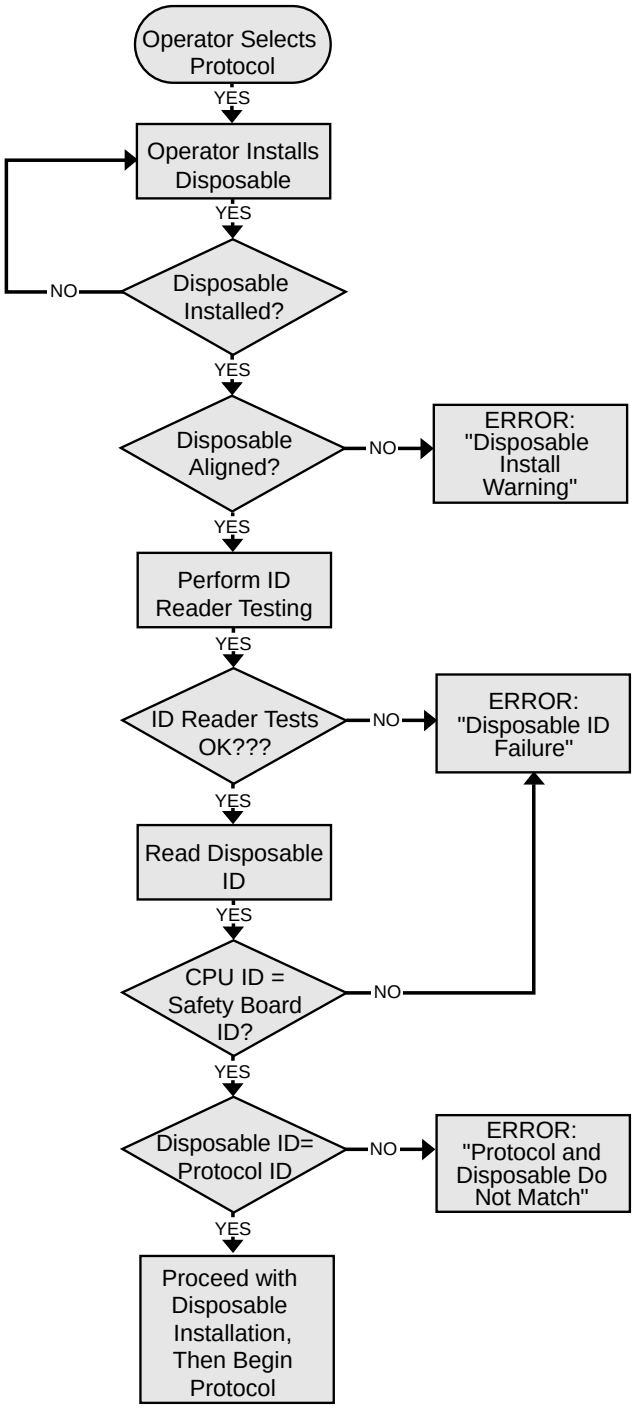


Figure 3-7, Disposable ID Flowchart

Disposable Loading

The MCS+ displays the active protocol and waits for the operator to install the disposable. When the bowl is placed in centrifuge well, the optics detect the presence of the bowl and the vacuum pump is turned on (for the vacuum centrifuge only).

During installation the display shows the interlocks and indicates when each is positively engaged by sounding a short audible beep and removing each message from the display as the interlocks are detected. Pressing the HELP key brings up the instructions for loading each part in order. As each set of interlocks is verified, the message changes to reflect the next step in the loading sequence. If the machine is in the Help mode when an interlock is engaged, the MCS+ prompts the operator to install the disposable and displays the following steps:

1. Load the Bowl
2. Close the Centrifuge Cover
3. Snap the Pump Cartridge in Place
4. Install the Tubing in the Line Sensor
5. Install the System Pressure Monitor (SPM)
6. Install the Donor Pressure Monitor (DPM)

All valves related to the detected protocol are open to ease installation of the tubing. Valves not used remain closed.

Note: **Icons are not displayed during this procedure.**
Once all of the items listed on the screen have been installed, the MCS+ generates a confirmation screen for the operator to check additional items that must be installed before continuing.

1. The Valves are Loaded
2. The Pump Tubing is Looped
3. The Bags are on the Weigher

Autoload Pumps

When all interlocks are detected and the Disposable ID is checked against the protocol card, the operator is prompted to press DRAW to autoload the pumps.

When DRAW is pressed, the pumps turn for three rotations (clockwise) to load the tubing into the pump heads. After 3 revolutions, the operator is prompted to confirm or reload.

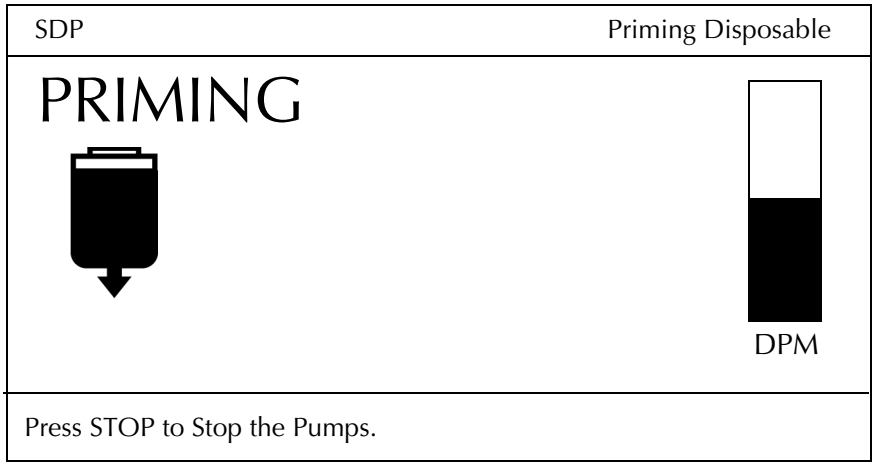
While the STOP key is active during the autoload process, the PUMP START/STOP key is also active and will stop the pumps if depressed.

When the pumps are loaded, the MCS+ waits for the operator to start the prime sequence by pressing PRIME, and to confirm the following:

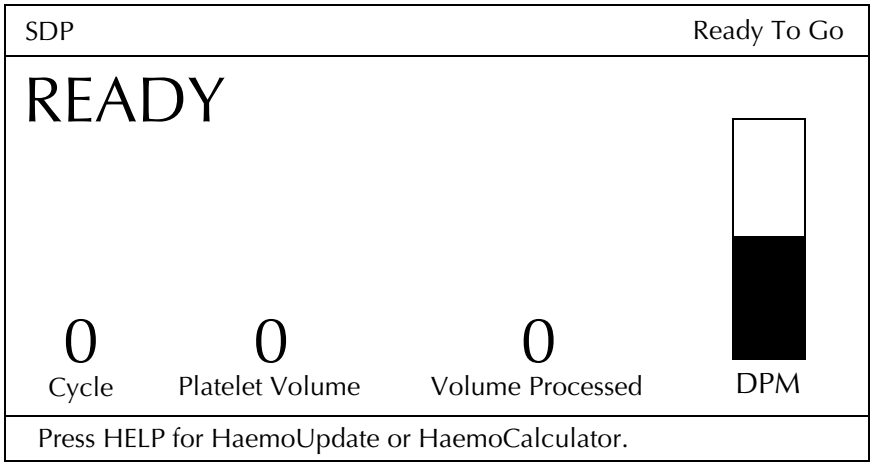
1. The Anticoagulant is Spiked
2. The Needle Line is Clamped
3. The Sample Pouch is Clamped

Prime

All prime sequences are protocol specific and the requirements for device monitoring, starting, and ending, of Prime.



Ready



In this mode, the MCS+ is ready to start a procedure. Press MODIFY to view or change any of the parameters.

Table 3-7 shows an example of the operator changeable parameters. These parameters are protocol-specific.

Table 3-7: Protocol Parameters

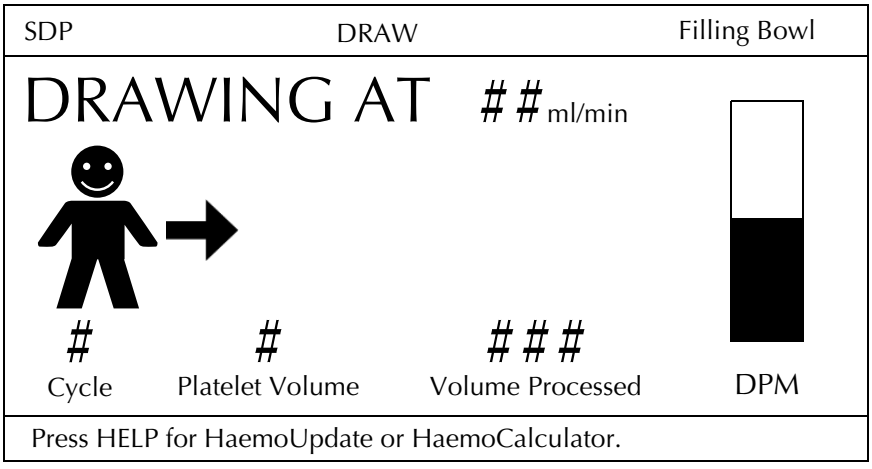
Single Donor Platelets				
Parameter	**Range**	**Default**	**Steps**	**Description**
Cuff Pressure	x-xxx mmHg	xxx	#	Donor cuff pressure
Draw Speed	xx-xxx ml/min	xxx	#	Default draw pump speed Modifiable in Ready and Return
Return Speed	xx-xxx ml/min	xxx	#	Default return pump speed Modifiable in Ready and Draw
Min Plt Volume	x-xxx ml	xxx	#	Determines whether additional plasma is diverted into the platelet bag and how much
Ratio	x:x-x:xx	x:xx	#	AC pump to blood pump ratio

MCS+ Process Monitoring

This section describes the normal process monitoring and resulting Notice messages for Draw and Return modes. The active protocol determines whether a device is utilized, therefore determining if a notice message is displayed. Not all notice messages discussed in the remainder of this section will be displayed for each protocol.

Draw Cycle

Pressing the DRAW key initiates the Draw Cycle by starting the centrifuge, pumps, and cuff, and auto-taring the weigher (1st cycle only). The MCS+ remains in Draw until the operator manually switches to another mode or the active protocol determines the end of the cycle.



The operator has the ability to change variables during collection without interrupting the protocol. See the *Modify* section for a description of the variables.

During the Draw cycle, the MCS+ follows a programmed sequence dependent on the active protocol.

Note: **If starting Draw from a recovery procedure, the weigher retains the last tared value and plasma weight.**

Error Codes During Draw

Table 3-8 shows the error codes that *may* occur during the Draw Cycle if a particular condition is detected. If an error occurs, press the HELP key to view more information.

The sections that follow describe the conditions that may have caused the error in more detail.

Table 3-8: Error Codes During Draw

Detection	Error Code (if test failed)	Text Area Description
Weight Removal	466	Remove All Weight From Weigher
Bowl Not Seated	27	Centrifuge Vacuum Not Detected
Centrifuge Problem	223 263	Centrifuge Cover Not Locked Centrifuge Cover Locked
Pressure Interlocks	255 256	DPM Filter Disconnected SPM Filter Disconnected
DPM No Response	373	No Donor Pressure Change Detected
Air	5 6 7 175	ACAD Detected Air DLAD1 Detected Air DLAD2 Detected Air BLAD Detected Air
Donor Pressure Monitoring	341	No Flow Detected from Donor
High System Pressure	259	SPM High Pressure Error
ECV Limit	62	Donor ECV Limit Reached

Weight Removal

When starting the Draw for the first time (new procedure, not recovery), if the plasma weight is greater than 60g, the MCS+ stops the pumps and prompts the operator to remove the bag. This prevents the bag from being tared with large plasma weights.

When the bag is removed, the MCS+ resumes operation and the operator can place the bag on the weigher arm.

Bowl Not Seated

If the active protocol uses the vacuum to retain the bowl in the centrifuge, the bowl vacuum is checked constantly during operation. If the vacuum at the bowl is detected to be insufficient (bowl vacuum switch open), processing is halted and a message is displayed informing the operator that the centrifuge vacuum is not detected.

Centrifuge Cover

If the centrifuge cover is open, the MCS+ displays a message stating the cover is open. Close and lock the centrifuge cover. The MCS+ displays a message confirming the cover is locked and prompts the operator to press DRAW to continue.

Pressure Interlocks

When the MCS+ detects that either the SPM or the DPM, or both, are not installed, it warns the operator by stopping the pumps (if running), and displays a message stating which filter has been disconnected.

When the SPM or DPM are reconnected, the MCS+ informs the operator that the filter has been restored and to press DRAW to continue.

DPM No Response

At the beginning of each Draw Cycle, a small negative change in pressure must be observed at the DPM as the blood pump rotates clockwise away from the donor. If a 5 mmHg drop is not observed, processing is halted and an audible warning is issued. The MCS+ informs the operator that no pressure change was detected at the DPM.

Pressing DRAW resumes the procedure and the display returns to normal.

Air in Anticoagulant Line

If air is detected by the ACAD, the machine stops the pumps, turns on the beeper at a rate of one beep per second, and reports the condition to the operator.

After the air has been cleared from the ACAD, the operator is prompted to press DRAW to resume the pass.

Air in Donor Line 1 or 2

If air is detected by the DLAD1 or DLAD2, the machine stops the pumps, turns on the beeper at a rate of one beep per second, and reports the condition to the operator. The centrifuge keeps running at its present speed.

After the air has been cleared from the DLAD1 or DLAD2, the operator is prompted to press DRAW to resume the pass.

Air in Blood Line

If air is detected by the BLAD 25 ml from the start of the Draw cycle, the machine stops the pumps, turns on the beeper at a rate of one beep per second, and reports the condition to the operator.

After the air has been cleared from the BLAD, the operator is prompted to press DRAW to resume the pass.

High System Pressure

If the pressure at the SPM is higher than its specification, then the bowl seal integrity might be compromised.

Note: **This is a condition which must be avoided since it will reduce the storage dating of the collected blood components.**
If the pressure is higher than 110 mmHg, the pumps stop, all keys are deactivated except the STOP key, and the centrifuge remains running. A valve may be opened to relieve pressure. The beeper is sounded at 1 beep per second, and the MCS+ displays an SPM high pressure error.

This state is maintained until the pressure drops 20 mmHg. To continue the procedure, the DRAW key is pressed.

Donor Pressure Monitoring

If the pressure at the DPM is lower than its specification, this indicates that a low flow condition is present. The blood pump speed is decreased in steps of 5 down to 20 after which it then goes to 0. The donor flow lights go from normal flow to low flow after the pump speed is two thirds of the desired speed, and then to no flow when the speed reaches 0. The machine beeps once every 5 seconds, and the MCS+ displays a warning message stating that no flow from the donor is detected.

When the donor pressure returns to an acceptable pressure, the blood pump starts at 20 and slowly increases back to the desired speed. When the pumps start, the donor lights go to low flow. When the speed is two thirds of the desired speed, the donor lights indicate normal flow.

Draw Regulation

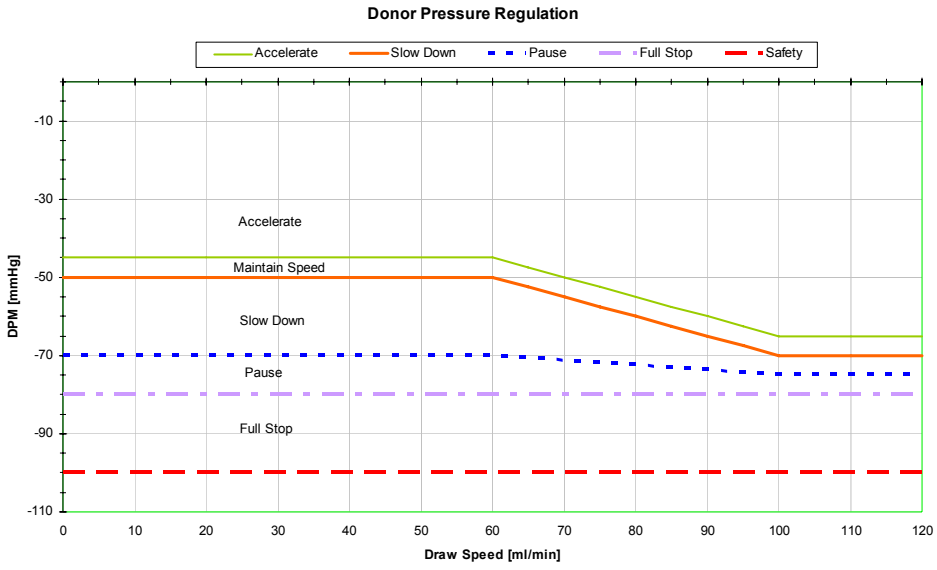


Figure 3-8, Draw regulation graph

Incomplete Return

At the beginning of each Draw Cycle (except the first) a flag is checked to see if the Return Cycle was completed. This flag is set in the ENDING RETURN state and will indicate that the entire contents of the bowl was returned. If the flag is set, it is reset and processing continues. If the flag is not set, processing is halted and the MCS+ displays a message stating the Return Cycle was not completed.

The operator must press RETURN to complete the Return Cycle.

Draw Cycle Too Long

The MCS+ has a volume limit which is determined by the active protocol. When this limit is reached, the MCS+ stops the pumps and displays a message stating the donor ECV limit is reached.

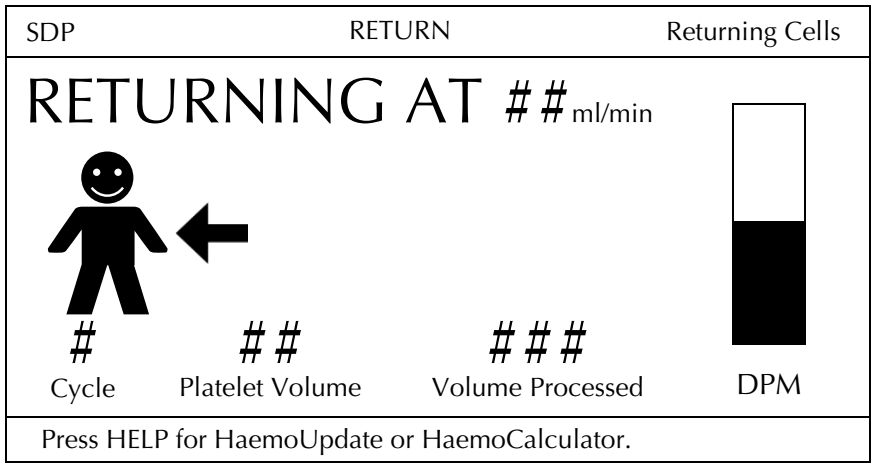
The operator is not allowed to continue Draw and must press RETURN to initiate the Return Cycle.

Pump Stop

When pumps are running, the PUMP STOP key on the panel allows the operator to stop the pumps without affecting any other machine function. When pressed, both pumps stop and a status message informs the operator that the pumps have stopped.

When pressed again, the pump or pumps restart at the previous speed and the status message is cleared from the display.

Return Cycle



During the Return Cycle, the pumps and centrifuge stop, the cuff deflates, and the blood pump reverses direction. The vacuum pump remains on. The MCS+ maintains this state until protocol specific instructions determine that the Return Cycle is complete.

The active protocol determines whether the specific targets for component collection have been satisfied. The active protocol also determines if a new Draw Cycle is entered or if the procedure has been completed.

Return Flow Control

During the Return Cycle, the pump speed is controlled by the SPM as shown in Table 3-9.

Table 3-9: Return Flow Control

Pressure	Action
<= -40 mmHg	Pumps stop
>= 260 mmHg	Pumps stop, display warning (High return pressure)
>= 200 mmHg	Pump speed decreases 5 ml/min/400 msec
>= 220 mmHg	Pump speed decreases 30 ml/min/200 msec
<= 140 mmHg	Pump speed increases 5 ml/min/sec

Return Regulation

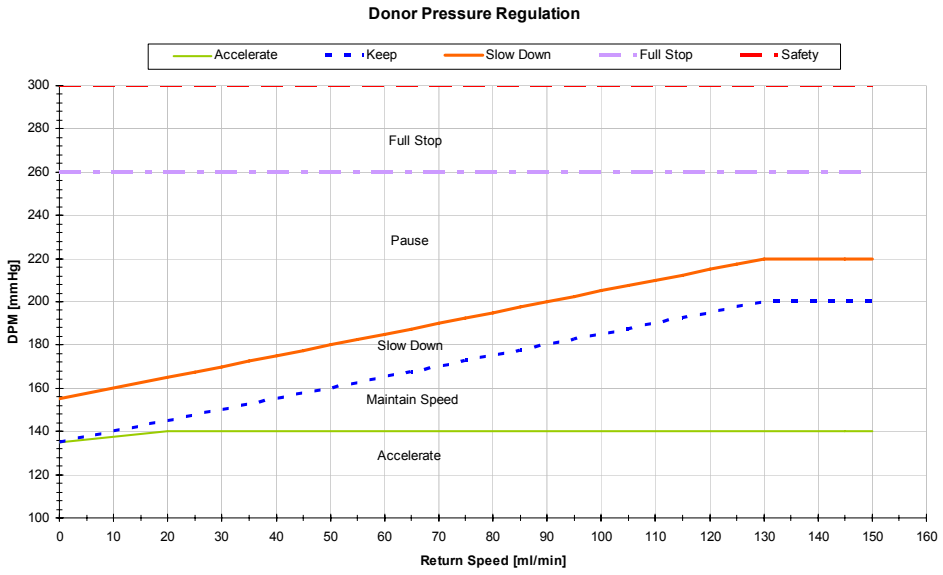


Figure 3-9, Return regulation graph

Error Codes During Return

Table 3-10 shows the error codes that *may* occur during the Return Cycle if a particular condition is detected. If an error occurs, press the HELP key to view more information.

The sections that follow describe in more detail the conditions that may have caused the error.

Table 3-10: Error Codes During Return

Detection	Error Code (if failure)	Text Area Description
High Return Pressure	257	High Pressure Error at DPM
Negative Return Pressure	258	Low Pressure Error at DPM
Low System Pressure	260	SPM Pressure Too Low
SPM No Response	374	No System Pressure Change Detected at SPM
Air	5 6 7	ACAD Detected Air DLAD1 Detected Air DLAD2 Detected Air
Air Detected Early by BLAD	102	Air Detected Earlier than Expected
Return Cycle Too Long	101	Max Return Volume Exceeded

High Return Pressure

When the pressure at the DPM is 260 mmHg or greater, the MCS+ stops the pumps, closes the donor valve, generates beeps at a rate of 1 beep per second, and displays a message stating the high pressure problem.

Negative Return Pressure

In the event a negative return pressure of -40 mmHg or more is sensed at the DPM, the blood pump stops, the donor valve closes, and the MCS+ displays a message stating the low pressure problem. The system will not restart until the DPM negative pressure has been relieved.

Low System Pressure

If the pressure at the SPM is lower than its specification, then the bowl seal integrity might be compromised.

Note: **This is a condition which must be avoided since it will reduce the storage dating of the collected blood components.**
If the pressure is lower than -90 mmHg, the pumps are stopped, the donor valve closes, and the beeper is sounded at 1 beep per second. The MCS+ displays a message stating the SPM pressure is too low.

This state is maintained until pressure changes 20 mmHg in the opposite direction and until the RETURN key pressed. For example, if the pressure is -90, the state remains until the pressure drops to -70 mmHg.

SPM No Response

At the beginning of each Return Cycle, a small negative change in pressure should be observed at the SPM as the blood pump rotates counterclockwise toward the donor with the plasma (yellow) and platelet (green) valves closed. If a 5 mmHg drop is not observed, processing is halted and an audible warning is issued along with a message stating the pressure problem.

Air Sensor Check

All air sensors are monitored during the Return Cycle. For all the air warning messages, the MCS+ beeps at a rate of one beep per second until the air is cleared.

Air in Anticoagulant Line

If air is detected by the ACAD, the MCS+ stops the pumps, turns on the beeper at a rate of one beep per second, and reports the condition to the operator.

After the air has been cleared from the ACAD, the operator is prompted to press RETURN to resume the cycle.

Air in Donor Line 1 or 2

If air is detected by the DLAD1 or DLAD2, the machine stops the pumps, turns on the beeper at a rate of one beep per second, and reports the condition to the operator. The centrifuge keeps running at its present speed. After the air has been cleared from DLAD1 or DLAD2, the operator is prompted to press RETURN to continue.

Air Detected Early, Blood Line Air Detector

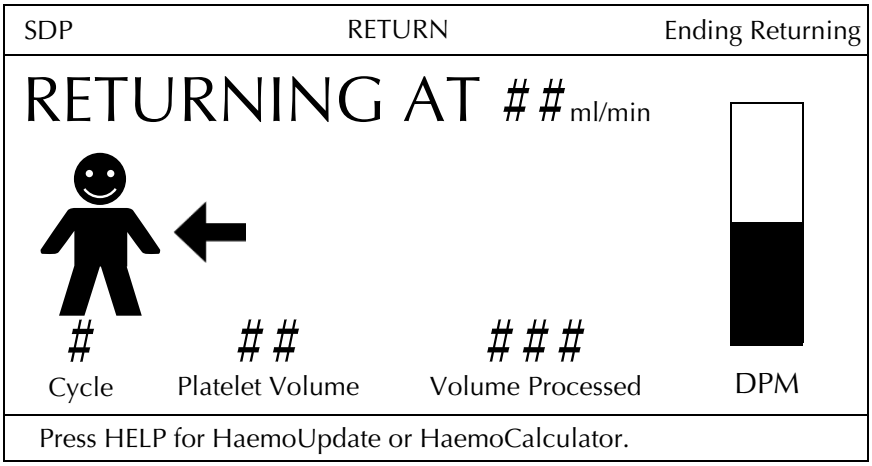
When air is sensed by the BLAD detector, one of two actions can occur:

1. If the volume returned is less than the bowl volume, the MCS+ assumes the bowl is not empty and displays a message stating air was detected earlier than expected.

   After the air has been cleared from the BLAD, pressing RETURN resumes the procedure and the display returns to normal.

2. If the volume returned is near the bowl volume, the machine displays ENDING RETURN. The pump slows to 40, pumping an additional 10 ml to empty the filter, and switches to the Draw Cycle or to PROCEDURE COMPLETE if its collection target is reached.

Ending Return



Return Cycle Too Long

If after returning a volume greater than the bowl, air is still not sensed in the BLAD, the MCS+ stops the blood pump and issues a warning with a beep every second. The MCS+ displays a message stating the maximum Return Volume has been exceeded.

Pressing RETURN continues the cycle with similar warnings every 50 ml if air is not sensed.

Pump Stop

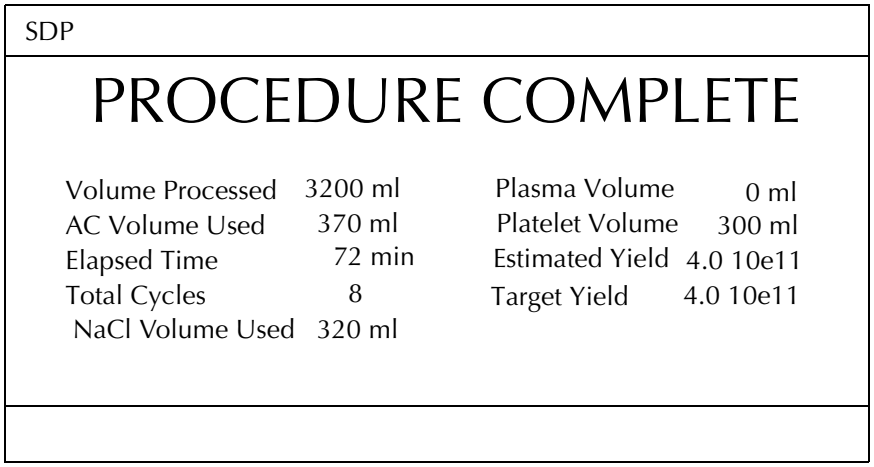
When the pumps are running, the PUMP STOP key on the panel allows the operator to stop the pumps without affecting any other machine function. When pressed, both pumps stop and a status message informs the operator that the pumps have stopped.

When pressed again, the pump or pumps restart at the previous speed and the status message is cleared from the display.

Disposable Unload

At the end of the procedure the protocol statistics are displayed so that they may be recorded. The statistics remain on the screen until the disposable is removed, at which time the MCS+ restarts for the next procedure. The following conditions must be met in order to start a new procedure:

- The centrifuge cover must be opened
- The pressure interlocks must be removed
- The bowl must be removed from the centrifuge well
- The pump manifold must be removed from the Disposable ID reader



Stop

Pressing the STOP key performs the following functions, without changing the parameters:

- Stops the pumps, centrifuge, and protocol-specified valves
- Exits the Draw or Return Cycle
- Puts the MCS+ in Ready mode
- Displays centrifuge braking until the centrifuge stops (if it was running at the time)

The MCS+ then enters the Ready mode. In the event that STOP was pressed during the Draw or Return Cycles, protocol specific parameters determine if the cycle can be continued where it was interrupted by pressing the respective key.

MCS+ System Monitor

The Perpetual System Monitor (PSM) is a process that executes in the *background* and continuously checks the system for the following:

- Watchdog signal
- Proper pump speeds, direction, ratios, and position
- Run away pumps
- Redundant centrifuge overspeed/underspeed monitoring and no motion detection
- Vacuum chuck pressure
- Centrifuge cover
- Spill detector
- Valve operation
- Safety system faults
- Interlocks
- ECV

PSM is active as soon as the machine is turned on and stays active until the machine is powered off. It runs simultaneously with any other machine mode. PSM is transparent to the operator unless an error is detected. In the event of an error, current processing is immediately terminated and the machine brought to a safe state.

There are two types of error messages:

- **RECOVERABLE**: Machine will allow operation if condition resolved.

  Non-critical errors result in a warning issued to the operator while the system is temporarily halted. The operator is allowed to view additional information by pressing the HELP key. The MCS+ suggests corrective action and processing can continue with a keypress.

- **UNRECOVERABLE**: Machine will not allow operation. The MCS+ must be powered off.

  Critical errors will result in a system-wide shutdown requiring the operator to go through a recovery procedure guided by the program. Process information from the aborted procedure is available by pressing the HELP key.

Whenever there is a malfunction with the MCS+ which cannot be corrected, the machine is brought to an appropriate state in which the following actions are performed:

- Power is cut off to pumps and centrifuge
- All valves are closed
- The watchdog ceases to be toggled which results in pump power being cut off via the pump relay opening
- An Error message is displayed
- The MCS+ beeps at a rate of once per second
- The operator is forced into the Recovery mode through a reboot

Recoverable Errors

Table 3-11 shows each of the recoverable errors and their associated error code, as well as a brief description of why the error may have occurred. See the Troubleshooting Chapter for more detail on a particular error code.

Table 3-11: Recoverable Errors

Problem	Error Code	Text Area Description	Description
Pump Problems			
Speed	41 45 40 44 42 46	Blood Pump Too Slow Blood Pump Too Fast AC Pump Too Slow AC Pump Too Fast White Pump Too Slow White Pump Too Fast	The speed of the pump indicated is beyond +/- 5 cc/min from its programmed value.
Ratio	59 57	AC/Blood Pump Ratio Low AC/Blood Pump Ratio Hi	The anticoagulant/blood pump ratio is beyond +/- 2 from its programmed value.
Direction	48 49 50	AC Pump Direction Wrong Blood Pump Dir. Wrong White Pump Dir. Wrong	The pump indicated is turning in the wrong direction. This information is supplied by the hardware.
Position	52 53 54	AC Pump Pos. Incorrect Blood Pump Pos. Incorrect White Pump Pos. Incorrect	The pump indicated is lagging or preceding its desired position by 128 counts. This error is posted by the Advanced Motor Driver PCB.
Centrifuge Problems			
Speed	39 26 25	Centrifuge Speed Too Slow Centrifuge Speed Too Fast Centrifuge Not Turning	The centrifuge speed is not within +/- 300 RPM from the commanded speed. The centrifuge is not running after 12 seconds.
Vacuum Pressure	27	Centrifuge Vacuum Not Detected	The centrifuge vacuum pressure is not within specification. The MCS+ monitors the vacuum pressure with digital information (1 or 0) provided by the hardware.
Valves			
Position Feedbck	58 226 227 229 228 225 224	Red Valve Out of Pos. Blue Valve Out of Pos. Yellow Valve Out of Pos. Green Valve Out of Pos. White Valve Out of Pos. Orange Valve Out of Pos. Purple Valve Out of Pos.	The valve indicated is out of position. All the valves are opened or closed and their respective position feedbacks are compared. Multiple valve switching from a single valve command is checked. The current feedback for each valve is verified to prevent overheating.

Table 3-11: Recoverable Errors (Continued)

Problem	Error Code	Text Area Description	Description
DPM and SPM Interlocks			
Pressure Interlcks	255 256	DPM Filter Disconnected SPM Filter Disconnected	Either or both filters are not installed. Once the active protocol requirements for the installation of filters are satisfied, the system confirms the installation and prompts the operator to press DRAW or RETURN to resume the procedure or press STOP to end the pass.

Unrecoverable Errors

The following sections describe the unrecoverable errors. In the event of an unrecoverable error, the MCS+ must be powered off.

Critical errors result in a system-wide shutdown requiring the operator to go through a recovery procedure guided by the program. Process information from the aborted procedure is available by pressing the HELP key.

Software Watchdog

The software watchdog algorithms provide assurance that program execution is proceeding in an expected manner by verifying the following:

- Control flow (program path) is executing in the correct sequence
- Relevant functions are entered and exited properly
- Program executes within defined timing requirements

Control Flow Checking

Control flow checking verifies that the sequence aspect of program flow is executed as defined. This is accomplished by pre-defining an expected program execution path. While the program is executing, the software watchdog compares the actual execution path versus the pre-defined path. In the event of an invalid comparison, the MCS+ immediately halts execution and places the machine state in an appropriate mode by turning off the pumps, centrifuge, cuff, closing the donor valve, and providing both an audible alarm and screen message. In addition, the watchdog timer is no longer toggled allowing the safety board to activate its safety mechanisms.

Function Checking

Routine checking verifies that a program segment (function, loop) is executed by monitoring its entry and exit points. In the event of a failure the MCS+ displays a message stating the safety system has encountered an error.

Timing Requirements

In addition to the sequential and function checking requirements of the software watchdog, a timing constraint ensures that the foreground program executes at an expected rate. This requirement is fulfilled when all the relevant software watchdog IDs are set within a two second period. This ensures that the CPU is not executing an unexpected endless loop or program segment which requires large amounts of CPU time. The function that performs this check is executed from a 50 ms interrupt just before the watchdog timer is toggled. When the timing requirement is expired, the MCS+ displays a message stating the safety system has encountered an error.

Safety System

During operation, the MCS+ checks the safety system error register at a 50 ms interval. If errors are reported, the MCS+ displays a message stating the safety system has encountered an error.

Internal Software Error

In the event that the computer "gets lost" and is unable to make a decision, the MCS+ displays a message stating the computer has encountered an error.

Table 3-12: Internal Software Errors

Error Code (if failure)	Type of Error
18	Fatal Error
0	Time Out Error
19	Stack Full Error
20	Stack Empty Error
22	Error Reading Queue
23	No Queue Found
24	Error Writing to Queue
32	AD Time Out Error
33	Sig Queue Full Error
34	Ack Error

Watchdog

The watchdog mechanism ensures that the CPU does not remain in an endless loop with no control over the machine. It ensures that the program is executing as expected. The watchdog signal has to satisfy the safety board with a 100 Hz square wave. This signal is issued from a CPU interrupt.

This interrupt occurs once the CPU has executed certain required steps which depend on the machine state.

In the event that incorrect steps have been executed or not executed at all, the machine shuts down all devices, displays an error code, and prevents further operation.

CPU Errors

Table 3-13: CPU Errors

Problem	Error Code	Description
Division by Zero	74	The CPU executed a division by zero.
Illegal Opcode	80	The CPU executed an illegal instruction.
Overflow Error	78	The CPU attempted to put information into a full stack and encountered an overflow error.
Array Bounds	79	The CPU program exceeded its array bounds.

Spill Detection

The sensor is a simple fluid sensitive switch; its output is 1 or 0. The MCS+ displays error code 28 and a message stating fluid has been detected in the centrifuge. The operator is prompted to press Help for more information.

Utilities

Utilities is an embedded set of special functions that allow the operator to perform calibration and diagnostic procedures.

- **Calibration** provides access to view and change the calibration values stored in the NVRAM of the Pressure Cuff, SPM, DPM, Weigher and Centrifuge. Calibration is also where the Machine Serial Number is programmed.
- **Diagnostics** provides access to a variety of tests that can be used to test virtually every system function.
- **Machine Parameters** provides access to the system clock, and allows setting of the date and time. It also provides access to clearing of the error history buffer.
- **Error History** provides access to the expansive error history buffer.

To access Utilities:

1. Ensure that at least one monitored disposable sensor (i.e.: DPM, SPM, Bowl, Centrifuge Cover Latch, or Disposable ID Sensor) is in an unloaded position. This will keep the Load Disposable screen displayed so that Utilities can be accessed.
2. Power on the MCS+ with the Diagnostics Protocol card installed.
3. Allow all the POST tests to be executed, and wait for the Load Disposable screen to be displayed.
4. Press the STOP key while the Load Disposable screen is displayed.

Note: **Alternately, Utilities can be accessed by pressing the STOP key any time the copyright screen is displayed, immediately after the MCS+ is powered on. However, this is NOT RECOMMENDED unless the POST test cannot be completed due to a POST test failure. In such a case, this provision to Utilities has been maintained. The risk of accessing Utilities at the copyright screen is that the pumps cannot be run in the Diagnostic Pump test without generating a Tag Byte Error, nor will the Diagnostic CRC test function properly.**

The Utilities menu is displayed, as shown:

CONFIGURATION
CALIBRATION CONFIGURATION DIAGNOSTICS Error History Machine Parameters DATA Management
Press STOP to start the Power On Self Tests. Press MODIFY to select, DRAW to enter selection. Press PRIME to print calibration/configuration data.

From the Utilities menu, the operator can select from the list of displayed options.

1. Press MODIFY to change the selection.
2. Press DRAW to execute the command.
3. Press STOP to exit the CONFIGURATION menu and to enter the Cycling program or to power off the MCS+.
4. Press PRIME to print calibration and configuration data.

Calibration

When Calibration is chosen from the Utilities menu, the calibration menu will be displayed.

Calibration Menu

The operator may select any of the options by pressing MODIFY to position the highlight and by pressing DRAW to select.

CALIBRATION
A/D CENTRIFUGE SERIAL NUMBER CPU BIOS CRC MCS TYPE CLEAR CRC'S Mechanical Centrifuge YES
Press STOP to return to the previous screen. Press MODIFY to select, DRAW to enter selection. Press SAVE to Store new Values and Update CRC.

Key Summary

- Press MODIFY to change the AD Calibration device selection.
- Press DRAW to program the offset value of the selected device.
- Press CUFF to turn the cuff compressor on or off.
- Press YES or NO to change the cuff dac data value.
- Press RETURN to program the full scale value of the selected device.
- Press STOP to exit the AD Calibration submenu and to return to the Calibration menu.
- Press SAVE to store new values and update CRC.

SPM Calibration

1. Press MODIFY to select the SPM device.
2. Remove any devices which may be connected to the SPM.
3. Press DRAW to program the current SPM signal value as the SPM offset.
4. Attach an SPM/DPM pressure test fixture to the SPM and pressurize the SPM to 300 mmHg.
5. Press RETURN to program the current SPM signal value as the SPM full scale.
6. Remove the SPM/DPM pressure test fixture from the SPM.

DPM Calibration

1. Press MODIFY to select the DPM device.
2. Remove any devices which may be connected to the DPM.
3. Press DRAW to program the current DPM signal value as the DPM offset.
4. Attach an SPM/DPM pressure test fixture to the DPM and pressurize the DPM to 300 mmHg.
5. Press RETURN to program the current DPM signal value as the DPM full scale.
6. Remove the SPM/DPM pressure test fixture from the DPM.
7. Press STOP to exit the AD Calibration submenu and to return to the Calibration menu.

Optics

The optics calibration submenu is used to display the digital values of the bowl optic and line sensor analog devices.

Calibration of these devices is accomplished by adjusting a potentiometer located on the devices and the CPU card.

Line Sensor Calibration

1. Remove anything which may be inserted in the line sensor tubing channel.
2. Clean the lens by flossing a lint-free cloth through the channel several times.
3. Remove the trim potentiometer access cover from the line sensor by prying it out.
4. Adjust the line sensor level to the current specification by turning the trim potentiometer.
5. Insert a black opaque shim into the line sensor tubing channel and confirm that the line sensor signal is within the current specification.
6. Replace the trim potentiometer access cover on the line sensor.

Bowl Optic Calibration

Use the current bowl optic calibration procedure as outlined in Bowl Optic Calibration (eight valve machine) on page 4-13. The general procedure is outlined below.

1. Confirm that the bowl optics are aimed correctly by following the current bowl optic aiming procedure as outlined in the appropriate manufacturing instruction (MI).
2. Remove disposables and fixtures from the centrifuge well.
3. Set the bowl optic offset to the current specification by adjusting the trim pot R2 located on the top (left) edge of the CPU card.
4. Place the bowl optic fixture into the centrifuge well and center the bowl optic beam on the photographic grey card, or equivalent. Although the beam should be centered, try to achieve the greatest reflectance as indicated by the bowl optic signal.
5. Set the bowl optic gain to the current specification by adjusting the trim pot located on the photo-optic assembly.
6. Recheck and adjust the bowl optic offset and gain until both values are within specification.
7. Remove the bowl optic fixture from the centrifuge well.
8. Press STOP to exit Optic Calibration and to return to the Calibration menu.

Centrifuge

Centrifuge calibration provides a means by which the centrifuge speed can be calibrated, and the MCS+ can be configured for either the mechanical or vacuum centrifuge. The centrifuge speed is calibrated by programming a variable called OUTVAL for two centrifuge speed setting: 7000 rpm and 3000 rpm. The MCS+ software is configured for the mechanical or **vacuum centrifuge by changing the "Mechanical Chuck" value to YES or NO.**

SPEED is the selectable speed point setting which is to be calibrated.

ACTUAL is the actual speed in rpm that the centrifuge is turning.

OUTVAL is the output value of the D/A converter, which is the set point control for the centrifuge speed.

VACUUM, used only for the vacuum centrifuge, represents the status of the vacuum switch. When the value is TRUE, a sufficient vacuum exists in the vacuum system to retain the bowl base while the centrifuge is spinning. When the value is FALSE, an insufficient vacuum exists in the vacuum system.

Mechanical Chuck represents the centrifuge configuration of the MCS+. When the value is YES, the MCS+ is configured for the mechanical centrifuge. When the value is NO, the MCS+ is configured for the vacuum centrifuge.

In a vacuum-configured machine, calibration of the centrifuge speed normally requires the installation of a bowl in the centrifuge (VACUUM = TRUE) before the centrifuge may spin. However, because it may sometimes be necessary to calibrate without a bowl installed, the centrifuge will spin after acknowledgement of a warning message.

In a vacuum-configured machine, the installation of a bowl is determined by the status of a vacuum switch. When VACUUM = TRUE, the vacuum switch is satisfied that a bowl is installed. When VACUUM = FALSE, the vacuum switch indicates that no bowl is installed.

CAUTION

At times the centrifuge bowl may not seat itself and properly load unless it is manually pushed onto the centrifuge spindle. This will be indicated by the status of the vacuum switch. If the warning message is displayed indicating that a bowl should be installed to perform this calibration, and a bowl is in the centrifuge well, but not seated, continuing may result in the centrifuge spinning without the bowl being properly loaded on the centrifuge spindle. This will damage the bowl, may damage the centrifuge, and will make a lot of noise.

CENTRIFUGE CAL		
SPEED	ACTUAL	OUTVAL
7000	####	####
3000	####	####
VACUUM = FALSE Mechanical Chuck = YES		
PRIME toggles vac. pump; DRAW/RET. controls the fuge; +/- increments/decrements outval; SAVE stores outval: STOP returns to the previous screen		

Key Summary

- Press PRIME to turn the vacuum pump on or off.
- Press DRAW to start the centrifuge.
- Press RETURN to stop the centrifuge.
- Press YES or NO to change the OUTVAL value for the selected centrifuge speed or toggle the centrifuge configuration.
- Press MODIFY to change the centrifuge speed selection between 7000 and 3000, or Mechanical Chuck.
- Press SAVE to save the OUTVAL values.
- Press STOP to exit the Centrifuge Calibration submenu and return to the Calibration menu.

Centrifuge Configuration

Before using the centrifuge, the software has to be configured to the type of centrifuge installed in the MCS+. “Mechanical Chuck = YES/NO” determines the centrifuge configuration. When “YES,” the MCS+ is configured for a mechanical centrifuge. When “NO,” the MCS+ is configured for a vacuum centrifuge.

1. Press MODIFY until “Mechanical Chuck” is highlighted.
2. Press the YES key to select a mechanical configuration or press the NO key to select a vacuum configuration.
3. Press the STOP key several times until the POST test bar graph is displayed, and then power off the MCS+.
4. Remove the bowl from the centrifuge, if there is one installed.

5. This step must be done without a bowl installed in the centrifuge. Power on the MCS+, allow the POST tests to complete, and then press the STOP key when the "Load Disposable" screen is displayed to access Utilities.
6. Press MODIFY and DRAW to access the Centrifuge Calibration screen.

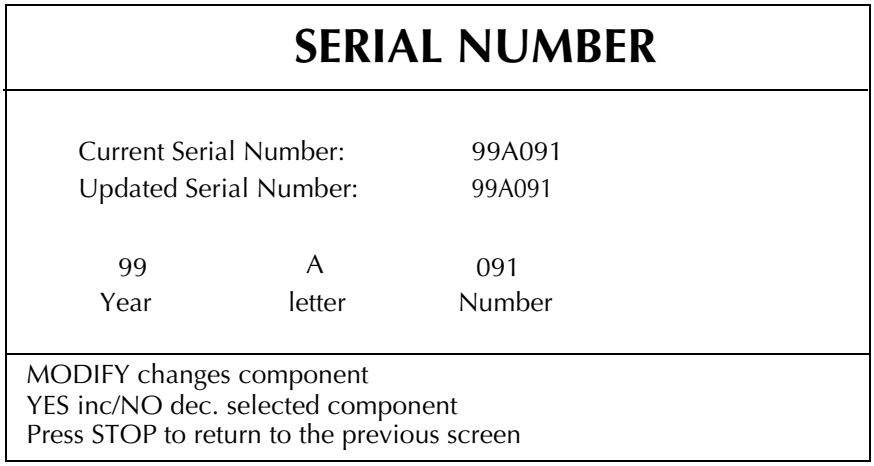
Centrifuge Calibration

Use the current calibration procedure as outlined in the appropriate manufacturing instruction (MI). The general procedure is outlined below.

1. For vacuum centrifuge configurations, press PRIME to turn the vacuum pump on, if it is not already on.
2. Install a bowl into the centrifuge. Ensure the vacuum status changes to true for vacuum centrifuge configurations, which indicates that the bowl is properly loaded.
3. Close the centrifuge cover halves and lock the cover latch.
4. Press MODIFY to change the SPEED setting to 7000 if it is not already set.
5. Press DRAW to start the centrifuge. Allow the centrifuge speed to stabilize at its maximum speed, which should be approximately 7000 rpm.
6. Press YES or NO to change the OUTVAL until the centrifuge ACTUAL speed matches the defined SPEED (7000 rpm).
7. Press MODIFY to change the SPEED setting to 3000.
8. After the speed has stabilized around 3000 rpm, press YES or NO to change the OUTVAL until the centrifuge ACTUAL speed matches the defined SPEED (3000 rpm).
9. Press SAVE to store the OUTVAL values. The OUTVAL values may change slightly when SAVE is pressed. This is normal.
10. Press RETURN to stop the centrifuge.
11. Press STOP to exit the Centrifuge Calibration submenu and return to the Calibration menu.

Serial Number

Serial Number Calibration provides a means by which the machine serial number can be programmed into memory. This information is used for Data Logging, in which the machine serial number is downloaded on the serial port and recorded on an external device along with other machine parameters.



Key Summary

- Press MODIFY to change the variable selection.
- Press YES or NO to change the value for the selected variable.
- Press SAVE to store the new information.
- Press STOP to exit the Serial Number Calibration submenu and return to the Calibration menu.

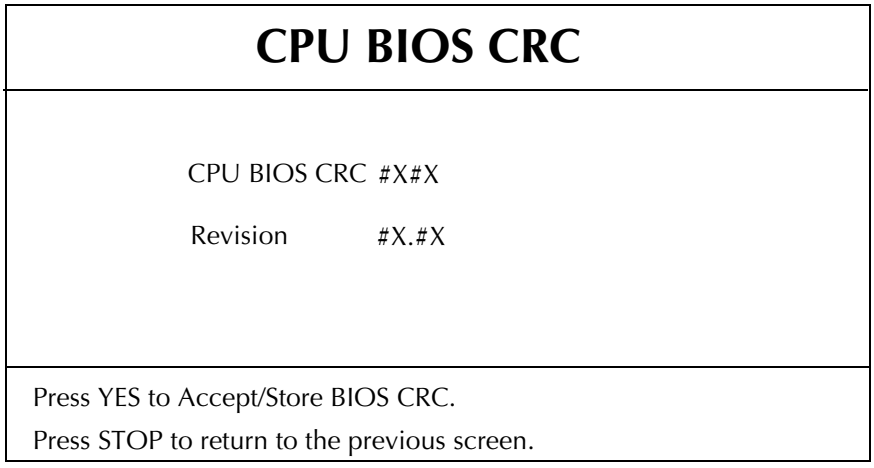
Serial Number Calibration

Use the current serial number calibration procedure as outlined in the appropriate manufacturing instruction (MI). The general procedure is outlined below.

1. Press MODIFY to select Year, if it is not already selected.
2. Press YES or NO to change the value to the desired value.
3. Press MODIFY to select Letter.
4. Press YES or NO to change the value to the desired value.
5. Press MODIFY to select Number.
6. Press YES or NO to change the value to the desired value.
7. Press SAVE to store the new information in the field Updated Serial Number.
8. Press STOP to exit the Serial Number Calibration submenu and return to the Calibration menu.

BIOS CRC

The BIOS CRC calibration provides a means by which the CRC of the ROM BIOS on the AMPRO CPU core module can be programmed into NVRAM and verified. The BIOS CRC is tested during protocol POST to confirm that the ROM BIOS binary image is intact. To facilitate the comparison of the expected BIOS CRC and the calculated BIOS CRC, a copy of the expected BIOS CRC must be stored in a memory location.



- Press YES to Accept/Store the BIOS CRC.
- Press STOP to exit the BIOS CRC Calibration submenu and return to the Calibration menu.

The BIOS CRC calibration automatically scans the installed ROM BIOS binary image and displays the CRC and the Revision of the binary image. The calibrator must compare the displayed information with that which is expected, from information provided by the CPU manufacturer (AMPRO core module) to confirm that the BIOS CRC is correct. If correct, then the BIOS CRC can be stored by pressing the YES key.

Clear CRCs

CLEAR CRC S
CALIBRATION CRC PROTOCOL CRC RECOVERY CRC CPU BIOS CRC CONFIGURATION CRC
Press DRAW to clear the Selected CRC Press MODIFY to change Selection Press STOP to return to the previous screen

The Cyclical Redundant Checksum (CRC) of three data groups is calculated and stored in NVRAM. These data groups include: Calibration, Protocol, and Recovery. Each time the MCS+ is powered on, the Calibration and Protocol CRCs are calculated and compared to values which were previously stored in NVRAM. The Recovery CRC is only checked if the Recovery option is selected when the MCS+ is powered on.

If the Calibration CRC is found to differ from the stored value, a non-recoverable error occurs, which can only be cleared by recalibration of the devices whose values are stored in NVRAM, and/or repairing the cause of the CRC difference.

If the Protocol CRC is found to differ from the stored value, a simple message is displayed indicating that the protocol card is different from the last installed protocol card. By acknowledging this, all configurable parameters in Modify, HaemoCalculator, and Configuration are set to their default values.

If the Recovery CRC is found to differ from the stored value, the data is considered corrupt and unusable, and the MCS+ powers up as if no recovery option had been selected.

The ability to clear the CRCs is only useful in an R&D test environment. Clearing the Protocol or Recovery CRCs will not have any significant impact, aside from resetting the Modify, HaemoCalculator and Configuration parameters as described above.

Warning! **Clearing the Calibration CRC will require that all devices whose calibration values are stored in NVRAM be recalibrated.**

Exiting Calibration

Pressing STOP exits the Calibration menu and brings the MCS+ back in the Utilities menu.

CONFIGURATION
CALIBRATION CONFIGURATION DIAGNOSTICS Error History Machine Parameters DATA Management
Press STOP to start the Power On Self Tests. Press MODIFY to select, DRAW to enter selection. Press PRIME to print calibration/configuration data.

Diagnostics

This section describes the diagnostic functions available to the MCS+. Diagnostics provides a complete collection of test functions that exercise or test each MCS+ subsystem.

When Diagnostics is selected from the Utilities menu, the diagnostic menu shown below is displayed.

DIAGNOSTICS	
ROM	KEYBOARD
PUMPS	CENTRIFUGE
VALVES	DONOR LITE
SAFETY	TRANSDUCERS
WEIGHER	AIR DETECTORS
PRESSURE	DISPOSABLE ID
DISPLAY	BAR CODE READER
Press STOP to return to the previous screen. Press MODIFY to select, DRAW to enter selection.	

- Press MODIFY to select a diagnostic test.
- Press DRAW to execute the selected diagnostic test.
- Press STOP to exit Diagnostics, and display the CONFIGURATION menu.

Note: **Refer to Chapter 4 for the recommended preventive maintenance procedure.**

ROM Diagnostics

ROM diagnostics provides access to the CRC-CCITT values that the program uses to verify its integrity. The expected value is read from the memory area under check and compared with the calculated values. If the two values match, the test will pass. Otherwise, the test will fail. Errors in data groups or damaged devices can be checked in this way.

The test is automatically executed when DRAW is pressed to access this test. After a short delay, the calculated values and the status of each test will be displayed.

ROM DIAGNOSTICS

Memory Component	Expected	Calculated	STATUS
SMART CARD CRC	XXXX	XXXX	PASS
CALIBRATION CRC	XXXX	XXXX	PASS INTL
CONFIGURATION CRC	XXXX	XXXX	PASS
Parameter Set	Card Rev.	NVRAM Rev	Compatible
CALIBRATION REV.	XX.XX	XX.XX	YES
CONFIGURATION REV.	XX.XX	XX.XX	YES

Press STOP to return to the previous screen.

Press STOP to exit ROM Diagnostics and to return to the Diagnostic menu.

Pump Diagnostics

Pump diagnostics provides the ability to test the function of the three peristaltic pumps, and the Drip Monitor.

The safety system is active during the pump diagnostic tests. Therefore, all safety system requirements must be satisfied before the pumps can be operated. The disposable ID sensor, DPM, SPM and all four air detectors must have disposable samples installed, and the four air detectors must sense fluid. Failure to satisfy the safety system may result in an unrecoverable error message, or a system reset.

When the START / STOP key is pressed, the pumps begin to turn in the direction specified by the machine state selected: All pumps turn clockwise in the Draw state, and only the Blood and White pumps turn counter-clockwise in the Return state.

The detected speed of each pump is displayed under the heading “Pump Speed,” and represents the speed of each pump in RPM. The accumulated volume of each pump is displayed under the heading “Volume,” and represents the volume each pump has accumulated in ml. 1 pump revolution is equivalent to 1 ml.

The AC ratio can be changed at any time. Increasing the AC ratio lowers the speed of the AC pump. Lowering the AC ratio raises the speed of the AC pump.

The accumulated number of detected drips from the Drip Monitor is displayed under the heading “Selected Speed.” The accumulated volume as detected by the drip monitor is displayed under the heading “Volume,” and is represented in ml. 18 detected drips is equivalent to 1 ml.

PUMP DIAGNOSTICS

	Selected Speed	Volume Processed	Actual Speed
BLOOD Pump	XX	XX	XX
AC Pump		XX	XX
RECIRC Pump	XX	XX	XX
AC Ratio 1:	XX		
DRIP MONITOR	XX	XX	

PRIME --> Transfer; DRAW --> Draw; RETURN --> Return
Modify selects; YES inc./NO dec. selected option.
Press STOP to return to the previous screen.

- Press MODIFY to select the Draw or Return pump direction.
- Press YES or NO to change the AC Ratio.
- Press pump START / STOP to start or stop the pumps.
- Press UP ARROW or DOWN ARROW to change the pump speed.
- Press STOP to exit Pump Diagnostics and to return to the Diagnostic menu.

Valve Diagnostics

Valve diagnostics provides the ability to test the pneumatic pinch valves. Each valve can be manually opened or closed, or the entire valve set can be repeatedly cycled opened and closed.

When each valve is opened or closed, the three status columns, (titled “Command,” “Feedback,” and “Current”) display the status of each valve. The Command column indicates the position that the valve has been commanded to assume. The Feedback column indicates the actual position of the valve as reported by a position switch inside the valve. The Current column does not have any relevance.

When the DRAW or RETURN key is pressed, the selected valve opens or closes. When the PRIME key is pressed, the entire valve set is cycled. Each valve is individually opened, then each valve is individually closed. The rate of the cycle can be controlled by changing the Interval. As the interval is increased, the valve cycle speed is decreased. As the interval is decreased, the valve cycle speed is increased.

If a valve is detected out of position, the Error counter begins to accumulate. The Error counter only indicates that a failure has occurred; it does not repeat the actual number of valve failures.

Note: **The clear valve is present on the eight-valve machine only.**

VALVE DIAGNOSTICS				
Valve	Command	Feedback	Current	
PURPLE	OPENED	OPENED	OPENED	Interval
ORANGE	OPENED	OPENED	OPENED	
RED	OPENED	OPENED	OPENED	
BLUE	OPENED	OPENED	OPENED	Errors
WHITE	OPENED	OPENED	OPENED	
YELLOW	OPENED	OPENED	OPENED	
GREEN	OPENED	OPENED	OPENED	
CLEAR	OPENED	OPENED	OPENED	
DRAW/RET control selected value; PRIME toggles cycling. YES inc/NO dec the interval; MODIFY selects the value. Press STOP to return to the previous screen.				

- Press MODIFY to select a valve.
- Press DRAW to open the selected valve.
- Press RETURN to close the selected valve.
- Press PRIME to start or stop valve cycling.
- Press YES or NO to change the Interval.
- Press STOP to exit Valve Diagnostics and to return to the Diagnostic menu.

Safety Diagnostics

Safety diagnostics provides access to the pressure devices and the weigher device signals, and displays them as a digital value. Each of the devices can be viewed under normal, low and high bridge load conditions. The pressure devices are the DPM and SPM, and the weigher device is the Weigher.

SAFETY DIAGNOSTICS
PRESSURE WEIGHER
Press STOP to return to the previous screen. Press MODIFY to select, DRAW to enter selection

- Press MODIFY to select a test.
- Press DRAW to execute a test.
- Press STOP to exit Safety Diagnostics and to return to the Diagnostic menu.

When the pressure test has been selected, the MODIFY key can be pressed to cycle through each bridge loading position of the pressure circuit, and the resulting values displayed for the DPM and SPM can be compared to a known specification.

SAFETY DIAGNOSTICS	
Bridge Loading =	NORMAL
DPM Value =	XXXX
SPM Value =	XXXX
Press STOP to return to the previous screen. MODIFY cycles through the tests.	

When the weigher test has been selected, the MODIFY key can be pressed to cycle through each bridge loading position of the weigher circuit, and the resulting values displayed for the weigher can be compared to a known specification.

SAFETY DIAGNOSTICS	
Bridge Loading =	NORMAL
Weigher Value =	X
Press STOP to return to the previous screen. MODIFY cycles through the tests.	

- Press MODIFY to select a bridge loading.
- Press STOP to exit Safety Diagnostics and to return to the Diagnostic menu.

Weigher Diagnostics

Weigher diagnostics provides the ability to view the offset reading of the weigher signal and the calculated weight on the weigher.

The weigher offset is an instantaneous value measured when the weigher diagnostics test is selected. Therefore, all weight should be removed from the weigher before selecting the weigher diagnostics test to ensure that the offset value is accurate.

The weight value is computed by using the calibration values that were programmed in for the offset and 1000 gram weight levels. It displays the actual weight on the weigher, within the defined specification. The calibration and linearity of the weigher can be tested by hanging different mass values on the weigher and comparing the results to a known specification.

WEIGHER DIAGNOSTICS		
Actual Offset	XXX	Calibrate Offset XXX
Actual Weight	XXX	Absolute Weight XXX
AD Reading	XXX	
STOP returns to the previous screen.		

Press STOP to exit Weigher Diagnostics and to return to the Diagnostic menu.

Pressure Diagnostics

Pressure diagnostics provides the ability to view the offset value and the pressure value for each pressure device: the DPM, SPM and Cuff. The offset values are instantaneously measured when the pressure diagnostics test is selected. Therefore, all pressures should be removed from the SPM, DPM and Cuff before selecting the pressure diagnostic test.

The pressure values are computed by using the calibration values that were programmed in for the offset and 300 mmHg pressure levels.

The status of the SPM and DPM filter interlock switches is also displayed. When a filter is installed, the status of both switches is "Closed." When a filter is removed, the status of both switches is "Opened."

PRESSURE DIAGNOSTICS

			CONNECTOR	
	PRESSURE	OFFSET	Switch 1	Switch 2
DPM	XX mmHg	XXXX	CLOSED	CLOSED
SPM	XX mmHg	XXXX	CLOSED	CLOSED
CUFF	XX mmHg		Cuff Pressure XX	

Press CUFF to toggle the cuff; +/- to change pressure
Press STOP to return to the previous screen.

- Press CUFF to turn the cuff on or off.
- Press STOP to exit Pressure Diagnostics and to return to the Diagnostic menu.

Display Diagnostics

The Display diagnostics test simply turns on every display pixel for approximately 3 seconds, and then turns off every display pixel for approximately 2 seconds. After the test is completed, the test automatically returns to the Diagnostics menu.

Keyboard Diagnostics

Keyboard diagnostics provides the ability to test the function of each key on the keyboard. Each time a key is pressed, its assigned function is displayed. The exception is the STOP key, which exits the test as usual.

KEYBOARD DIAGNOSTICS

Key Pressed = DRAW

Press STOP to return to the previous screen.

- Press each key, except STOP, to display its respective assigned function.
- Press STOP to exit Keyboard Diagnostics and to return to the Diagnostics menu.

Centrifuge Diagnostics

Centrifuge diagnostics provides access to centrifuge speed, vacuum (for vacuum centrifuge only), and fluid detection tests.

The centrifuge can be operated at a variety of speeds. The vacuum pump, vacuum switch (for vacuum centrifuge only), the centrifuge cover, the centrifuge relay, the spill detector, and the vacuum dump valve can all be tested and monitored. Press PRIME to turn the vacuum pump on or off.

CENTRIFUGE

Status:	OFF	Centrifuge Relay:	CLOSED
Selected Speed:	4800	Vacuum:	TRUE
Centrifuge Speed:	0	Centrifuge Cover:	CLOSED
Centrifuge DAC:	0	Spill Detector:	FALSE
		Dump Valve:	CLOSED

YES inc/NO Dec the fuge speed; CUFF toggles Dump Valve;
PRIME toggles vac. pump; DRAW/RET. controls the fuge
Press STOP to return to the previous screen.

- Press DRAW to start the centrifuge.
- Press YES or NO to increase or decrease the centrifuge selected speed.
- Press RETURN to stop the centrifuge.
- Press CUFF to open or close the vacuum dump valve.
- Open or close the centrifuge cover latch to open and close the centrifuge relay and centrifuge cover switches.
- Press STOP to exit Centrifuge Diagnostics and to return to the Diagnostics menu.

Donor Light Diagnostics

Donor light diagnostics provides the ability to test all four sets of donor lights on the machine.

The tests are comprised of the following donor light combinations: All On, All Off, Normal Flow, Low Flow, No Flow, Return Flow.

DONOR LITES
Donor Lights Status = NORMAL FLOW
MODIFY cycles through tests. Press STOP to return to the previous screen.

Transducers Diagnostics

AD DIAGNOSTICS			
WEIGHER	XXXX	SPM PRESSURE:	XXXX
SPARE Weigher 2:	X	*SPARE Press	X
SPARE Weigher 3:	X	LINE SENSOR:	X
80% TEST:	X	*SPARE L.S. 1:	X
50% TEST:	X	*SPARE L.S. 2:	X
20% TEST:	XXXX	BOWL OPTICS:	XXXX
CUFF Pressure:	XXXX	SPARE B.O.:	X
DPM Pressure:	XXXX	Ground:	X
Press CUFF to toggle the cuff; +/- to change pressure Press STOP to return to the previous screen.			

Transducers diagnostics, also called AD diagnostics, provides a table of all analog channels and their digital values, both used and unused. The raw values from the A/D converter are shown for each channel.

- Press CUFF to turn the cuff on or off.
- Press STOP to exit Transducers Diagnostics and to return to the Diagnostics menu.

Air Detector Diagnostics

Air detectors diagnostics provides a table indicating the status of all air detectors. When an air detector has no tubing installed, or if an air bubble is in the air detector channel, the status of that air detector is Air. When a piece of fluid filled tubing is installed in an air detector, its status changes from Air to Fluid.

AIR DETECTORS

AIR DETECTORS	Status
THE ANTICOAGULANT AIR DETECTOR (ACAD)	FLUID
THE BLOOD LINE AIR DETECTOR (BLAD)	AIR
THE DONOR LINE AIR DETECTOR 1 (DLAD1)	FLUID
THE DONOR LINE AIR DETECTOR 2 (DLAD2)	FLUID

Press STOP to return to the previous screen.

Press STOP to exit Air Detectors Diagnostics and to return to the Diagnostics menu.

Disposable ID Diagnostics

Disposable ID diagnostics provides access to the hexadecimal value computed from the Disposable ID reader. When various disposable pump cartridges are installed with different bar codes affixed to the base, the Disposable ID reader communicates information that is translated into a hexadecimal code. The displayed hexadecimal code can be compared to a known specification to ensure the proper operation of the Disposable ID reader and associated circuitry.

The Raw Data screen displays the 8 bit hexadecimal code as read from the Disposable ID sensor. The Disposable ID screen displays the computed hexadecimal Disposable ID, which is the raw data, minus the two framing bits and then divided by 2.

DISPOSABLE ID

RAW DATA = FF
DISPOSABLE ID = 3F

Press STOP to return to the previous screen.

Network Diagnostics (Only 7 valve machine)

Network diagnostics provides confirmation that the RS-232 serial port is functioning correctly. The serial port is tested by displaying the hexadecimal network data record request number that is sent by the PC utility DHHost, and by displaying the Diagnostic program Version and CRC on the PC monitor. To perform this test, the data-logging communication port of an IBM compatible PC running the application DHHOST.EXE is required.

NETWORK DIAGNOSTICS
NETWORK TESTING Request #: #X#X
Press STOP to return to the previous screen.

Bar Code Diagnostics (Only 8 valve machine)

The bar code reader diagnostic provides the ability to view the code read by the bar code reader if the reader is correctly installed.

BAR CODE DIAGNOSTICS
Bar Code Reader Input Value = XX.XX
Press STOP to return to the previous screen.

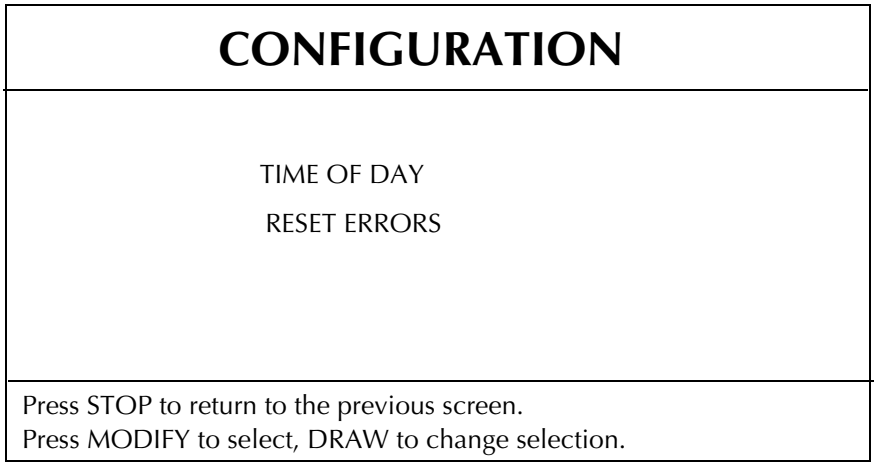
Machine Parameters

The Machine Parameters menu provides two important functions: setting the MCS+ date and time clock, and resetting the error history buffer.

When the MCS+ is initially calibrated, the date and time must be set. Date and time information is included in Data Logging, and is used to time and date stamp the procedure information.

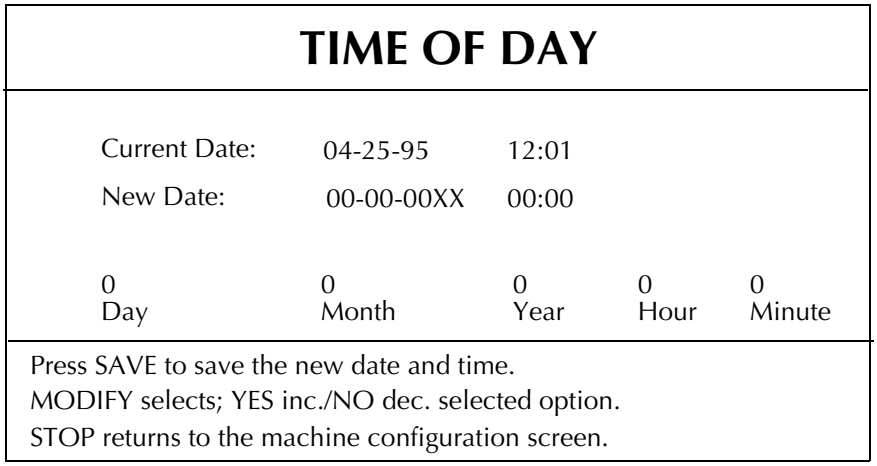
Whenever the MCS+ is installed in a new location outside of the time zone in which the Time Of Day was originally set, the time and date must be updated to reflect the current time and date.

The error history buffer should be viewed, recorded and reset whenever service is performed on the machine. See the *Error History* section of this chapter for more information.


CONFIGURATION
TIME OF DAY
RESET ERRORS
Press STOP to return to the previous screen.
Press MODIFY to select, DRAW to change selection.

Time of Day Settings

The date and time are set in 24 hour format. Whenever the MCS+ requires calibration or service, the date and time setting should be checked for accurate settings. Whenever the MCS+ is relocated, or whenever the time changes due to Daylight Savings Time, the date and time should be updated.


TIME OF DAY
Current Date: 04-25-95 12:01
New Date: 00-00-00XX 00:00
0 Day
0 Month
0 Year
0 Hour
0 Minute
Press SAVE to save the new date and time.
MODIFY selects; YES inc./NO dec. selected option.
STOP returns to the machine configuration screen.

1. Press MODIFY to change selection.
2. Press YES to increase value of selection.
3. Press NO to decrease value of selection.
4. Press SAVE to save the new settings as the new date and time. (Do this after changing all parameters.)
5. Press STOP to exit Time Of Day and to return to the Machine Parameters menu.

Reset Errors

The Reset Errors function provides the ability to clear all of the records in the error history buffer. It is intended to clear random data from the NVRAM when the power is first applied to the system, and to remove old error data from the error history buffer.

For more permanent storage, the error history data can be downloaded to the serial port at 9600 baud using 1 Stop bit an No parity bit. Information is sent as ASCII text.

RESET ERRORS

PRESS DRAW TO RESET THE ERROR DATA

Press STOP to return to the previous screen.
Press DRAW to reset the error data.
Press PRIME to print the error data to disk.

Error History

The Error History menu shows the last 10 errors that were stored in the error history buffer. The errors are listed in reverse order, with the most recent error located at Error 1.

If an error is selected, more detailed information about the error condition can be displayed.

Further, the state of the two safety channels on the safety card and the error stack at the time of the error can be displayed.

ERROR HISTORY

Error 1.	187	Error 6.	224
Error 2.	219	Error 7.	0
Error 3.	88	Error 8.	0
Error 4.	187	Error 9.	0
Error 5.	187	Error 10.	0

Press STOP to return to the previous screen.
Press MODIFY to select, DRAW to enter selection.

Error Information

By selecting the error number, detailed error information can be displayed to help identify the potential problem.

ERROR 1

Error Number:	187	Cycle Number:	4
Protocol:	SDP	Date:	1/17/94
Volume Processed:	234	Time:	14:04
Mode:	DRAW		
State:	2		

Press STOP to return to the main ERROR screen.
Press DRAW to show safety board status at error time.

Error Safety Board State

Detailed safety system register information can be displayed to help identify the potential problem.

ERROR 1

Channel 1				Channel 2			
1.	ff	6.	ff	1.	ff	6.	ff
2.	ff	7.	ff	2.	ff	7.	ff
3.	ff	8.	ff	3.	ff	8.	ff
4.	ff	9.	ff	4.	ff	9.	ff
5.	ff	10.	ff	5.	ff	10.	ff

Press STOP to return to the main ERROR screen.

Cycle Program

If the MCS+ is powered on with the Diagnostic card installed, and the Utilities menu is not intentionally invoked, the MCS+ will begin an automatic cycling program. This program simply runs the Diagnostic POST tests, autoloads the pumps, primes the AC line, and then runs a short Draw/Return Cycle. When the Return Cycle is complete, the MCS+ is rebooted, and the whole cycle repeats itself.

The total number of completed cycles is displayed on the screen while in Draw or Return. This number continues to accumulate until the machine has been powered off for more than one hour, or the Utilities menu is intentionally invoked.

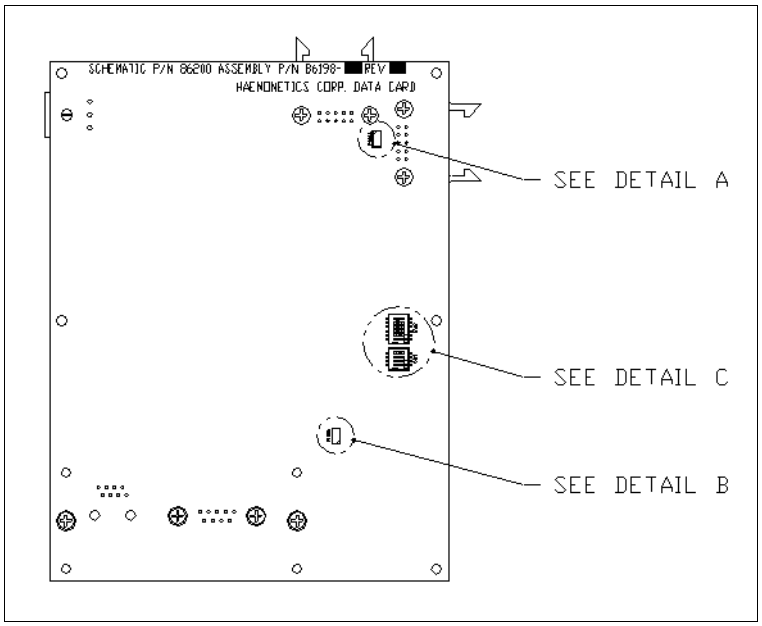
The cycling program requires that all safety system monitored devices are satisfied. This means that the DPM, SPM, Disposable ID sensor, Centrifuge Bowl Vacuum, and all four Air Detectors must have disposable segments installed. The pumps should also have tubing segments (attached to cartridges) installed. Although this is not mandatory to run the cycling program, frequent pump position errors may occur because the pumps may continue to turn after power has been removed due to inertia.

Infra Red Interface Setting

Note: **These checks are specific to the eight valve machine.**

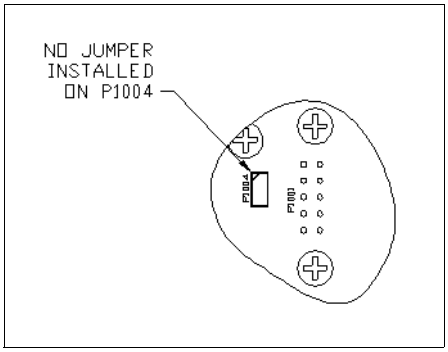
Rear Panel Setting Check

Note: **PCB view without components for clarity.**

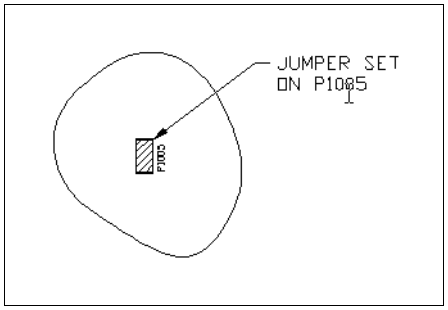


Jumper Check

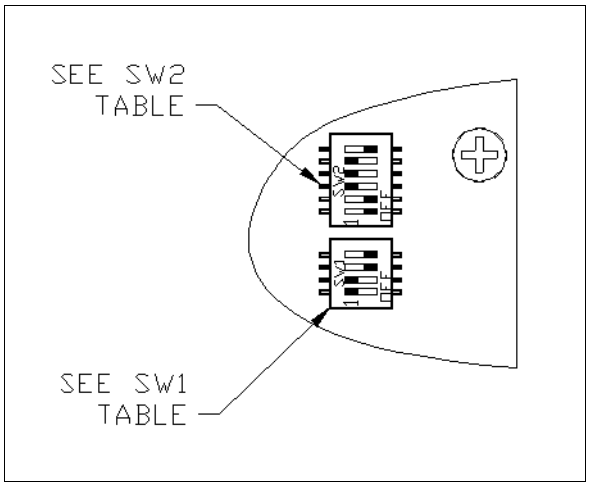
1. On the data card pcb (part of rear panel assembly), check that no jumper is installed on P1004.



2. On the data card pcb (part of rear panel assembly), check that a jumper is set on P1005.



Switch Setting Check



SW1 switch check

On the data card pcb (part of rear panel assembly), check that the baud rate is set at 19200 baud according to table below.

SW1 - 1	Set to ON
SW1 - 2	Set to ON
SW1 - 3	Set to OFF
SW1 - 4	Set to OFF

SW2 switch check

On the data card pcb (part of rear panel assembly), check that SW2 switches are set according to table below.

SW2 - 1	Set to OFF	Hardware mode
SW2 - 2	Set to OFF	Vout not powered
SW2 - 3	Set to ON	N/A
SW2 - 4	Set to ON	N/A
SW2 - 5	Set to ON	N/A
SW2 - 6	Set to ON	Bare Code Scanner Power enabled

Chapter 4
Preventive Maintenance

Initial Inspection

Visual Inspection

Visually inspect the following items to ensure that they appear to be in good working order and do not have obvious scratches, dents, broken or missing hardware. Note any physical damage on the service report. Tighten and/or replace hardware as necessary. Scratched and/or dented hardware need not be replaced unless the damage interferes with the operation of the machine.

- Outside of cabinet
- Cooling fans (mounted on the rear panel)
- Pressure cuff (Check for fatigue; cracking of the tubing or the cuff material and/or leaks when pressurized indicate the need for replacement.)
- Membrane panel
- Pump rotors
- Pump rotor screws (one in the center of each rotor)
- Tubing guides
- Weigher arm
- Screw for the weigher arm (at the pivot point of the weigher arm)[1]
- Centrifuge cover
- Screws in the hinge of the centrifuge cover
- Thumb screw cap (If missing, check that the screw in the center of the thumb screw is still in place and tight.)[2]
- Line sensor and cap
- Air detectors
- Drip monitor
- System and donor pressure monitor
- ID sensor

Ensure Initial Operational Integrity

Power on the LN 9000 and ensure that it passes the initialization and System Test Check before going on to test the machine. (This will assure you and the customer that the machine was operational before it was tested and alleviate any doubt whether the service engineer's adjustments caused a problem, should the machine fail to operate properly after the PM is complete.)

1. ≤ Rev. B 38057-00 load cell only
2. Vacuum style only

Record the Program Revision Level

The program revision level is displayed on the screen just after the screen lights up. The copyright screen appears and the revision level is displayed at this time. It appears within the first five seconds after power up.

System Cleaning (Optional - only performed as needed)

Vacuum Centrifuge

Well

Cover the hydrophobic filter first to ensure that it stays dry. Clean the centrifuge well using disinfectant cleaner. Spraying the cleaner into the centrifuge well is acceptable.

Centrifuge "L" Seal

A black "L" shaped seal is located in the lowest portion of the centrifuge well. To grease the "L" shaped seal, place a small amount of silicone grease on a finger, reach into the lowest part of the centrifuge and apply the grease on to the seal. If a seal looks damaged or worn, replace with a new seal.

Mechanical Centrifuge

Note: Inspect the mechanical "fingers" for free movement; if binding, complete the following procedure.

1. Secure Tool, Chuck Removal (ETE 5321 or equivalent) into the centrifuge chuck.
2. Using a 3/16 hex extension, loosen the center register screw; once loosened, remove the screw from the chuck. The center register screw has right hand thread; turn clockwise to loosen.
3. Carefully tap the handle of the tool upward to loosen the chuck. Slowly lift the chuck out of the centrifuge bucket, being careful not to damage the optics block.

Note: Lift the chuck at an angle to avoid the optics block aligning the cross bar on the chuck tool parallel with the optics block.

4. Remove the six Phillips head screws from the bottom of the chuck and gently pry the plate away from the chuck.
5. Using a water and bleach (10%) mixture, clean the chuck of all foreign particles, using a toothbrush to clean the *locking fingers.* Rinse the chuck completely with water and allow to dry.

Note: Check all locking fingers for proper movement. They must be free from any binding.

6. Reassemble the chuck and secure the tool if removed.
7. Carefully lower the chuck into the centrifuge bucket. Be sure that the Hex chuck center sides are aligned properly with the motor shaft Hex and is fully seated.
8. Secure the chuck with the previously removed screws.

Note: **Ensure the bowl loading force has not changed and complete a bowl vibration test. Complete the diagnostic test outlined in this chapter.**

Optics Lens

Use disinfectant cleaner applied to a paper towel or soft cloth dampened with water. Clean the optic window and ensure that it is free of all substances that may affect the transmission of light.

Drain Tube

Ensure that the drain tube is free from obstruction that would inhibit the flow of fluid from the centrifuge to the drain cup.

Cover

Clean the centrifuge cover, using disinfectant cleaner applied to a paper towel or soft cloth dampened with water.

Pumps

Rotors & Rollers

Remove the rotor assembly from each pump and wash in warm water. Ensure that all the rollers spin freely. If they do not, let the rotor soak for one hour and then check again. Replace if necessary. Rinse the rotor thoroughly, and dry it completely before reinstalling in the machine. If available, use compressed air to dry the rotors.

Pump Cavity

Clean the pump cavity, using disinfectant cleaner applied to a paper towel or soft cloth dampened with water. Do not spray the cleaner directly into the pump cavity.

Line Sensor

Clean the line sensor housing, using disinfectant cleaner applied to a paper towel or soft cloth dampened with water. Also, clean the line sensor lens and ensure that it is free of all substances that may affect the transmission of light.

Membrane Panel

Clean any contamination from the membrane panel and display, using disinfectant cleaner applied to a paper towel or soft cloth dampened with water. Do not spray cleaner directly on the front panel display.

Deck

Clean any contamination from the deck, using disinfectant cleaner applied to a paper towel or soft cloth dampened with water.

Donor Lites

Clean any contamination from all the donor light sets, using disinfectant cleaner applied to a paper towel or soft cloth dampened with water.

Air Sensors

Clean any contamination from the air sensors on the deck and front panel, using disinfectant cleaner applied to a paper towel or soft cloth dampened with water.

DPM/SPM Sensors

Clean any contamination from the DPM/SPM sensors, using disinfectant cleaner applied to a paper towel or soft cloth dampened with water. Using an alcohol swab, clean the metal luer fitting for the DPM/SPM assemblies.

Bar-code reader

The bar-code reader window should be wiped using a lint-free cloth or gauze and water, then dried. It should be cleaned whenever there is an accumulation of dust or spilled fluid. For optimal cleaning, the operator should remove the protector around the window and replace it once the window has been cleaned.

Cuff

If it is determined that the cuff has been contaminated, clean the affected area with a 10% bleach solution (or equivalent). If this cleaning is determined to be insufficient based on the severity of the contamination, a replacement cuff may be ordered and installed by the user.

Outside of Cabinet

Clean any contamination from the outside of the cabinet, using disinfectant cleaner applied to a paper towel or soft cloth dampened with water.

Equipment Integrity Inspection

Electrical Connections Inspection

1. Remove the front and back panels to gain access to the internal components.
2. Inspect for loose or broken electrical connections on all major assemblies. Tighten or repair as required.

Pneumatic Connections Inspection

Note: **Centrifuge vacuum items applicable only for the vacuum centrifuge.**

Inspect the pneumatic connections at the vacuum pump, cuff compressor, in-line filter, centrifuge connection, dump valve, pinch valves and top deck PCB and the pinch valve compressor. Tighten and repair as required.

Hardware Inspection

1. Inspect for loose or missing mounting hardware. Tighten and repair as required.
2. Inspect the centrifuge mounting location to ensure that the centrifuge does not contact the deck. There should be a clearance of at least 1/8 inch between the centrifuge and the cavity in the deck around the centrifuge, and a visible gap between the base of the centrifuge rim and the deck surface.

Refer to the centrifuge calibration section in Chapter 3 for alignment instructions if required.

Consumables Replacement

Replace or clean each of the following filters as needed.

- Large filter, P/N 17548-00
- Small filter, P/N 18138-00

The three air filters are located on the bottom of the machine.

Calibration Testing

Note: **When the MCS+ is powered on, the normal Power On Self Tests (POST) will be run, including CPU, RAM and display tests. You will hear an audible beep while the RAM test is run and the display will show all pixels on as part of the test. The Copyright screen will be displayed for about three seconds.**

Although not recommended, the STOP key can be pressed at this time to access the Utilities Menu. Access to Utilities has been provided at the Copyright screen in case the MCS+ fails the POST test.

Utilities should normally be accessed by pressing the STOP key at the Load Disposable screen. This ensures that all POST tests have been completed before attempting to run certain Diagnostic tests, which may otherwise fail. To access Utilities, be sure to leave at least one monitored disposable sensor off the machine (such as a DPM or SPM filter) to ensure that the Load Disposable screen will remain displayed long enough to press the STOP key.

If the STOP key is not pressed at the Copyright screen or at the Load Disposable screen, a cycling program is entered.

Setup

1. Install the Diagnostic protocol card (P/N 47536-00, Protocol Revision MCS+2 - DIAG - C.1 - EN) into the smart card reader.
2. Fully extend the weigher arm.

Power Supplies

1. Plug the MCS+ into the correct wall outlet source. Power on the MCS+ and the entire display lights up. Ensure all pixels (dots) are lit.
2. After the POST test, press and release the STOP key to enter Utilities.
3. Using a Voltage Meter, Fluke 21 or equivalent, set to DC volts, measure the power supply output voltages verifying that the voltages are within the specifications outlined in Table 4-1.
4. Test points are on the Advanced Personality PCB assembly on the rear of the card cage. (Refer to the Front Panel Disassembly.) Test points are located on the upper left hand side and are labeled left to right (TP6, TP1, TP2, TP3, TP4, TP5).
5. Use TP6 or chassis for system ground.

Table 4-1: Power Supply Voltages

Voltage (VDC)	Location
5.1 +1/-0	TP pin 1
15 +/- 0 .4	TP pin 2
-15 +/- 0.4	TP pin 3
28.375 +/- 1.5	TP pin 4
48.650 +/- 2.5	TP pin 5

6. Refer to the calibration section on page 4-18 if the supplies are not within specifications.

Error History

1. Use the MODIFY key to highlight ERROR HISTORY and then press DRAW.
2. Verify no trends of the same error are indicated; if so refer to the Troubleshooting chapter for assistance in determining the possible cause of the error.
3. Press STOP to exit.

Reset Errors (Optional Check)

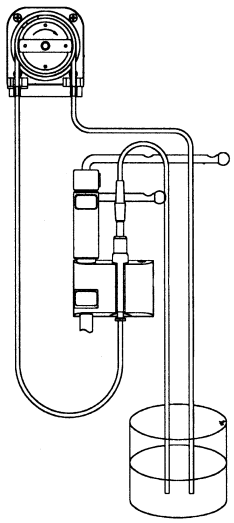
If necessary, use the following steps to erase error log in the NV RAM:

1. Use the MODIFY key to highlight MACHINE PARAMETERS, then press DRAW
2. Use the MODIFY key to highlight RESET ERRORS, then press DRAW.

Drip Monitor (Optional)

Note: **The following procedure may be done if a faulty drip monitor is suspected. This does not need to be done on a routine basis.**

1. Place disposable ID test fixture ETD-5155-1 (37635-00) (all white cartridge) into the bar code reader. Install filters on the DPM and SPM and insert water-filled tubing in all four air detectors.
2. Use the MODIFY key to highlight PUMPS and then press the DRAW key.
3. Load Drip Monitor Test Harness #ETC-5209 (or equivalent) as shown. Route tubing through the AC pump and drip monitor and into a container with water as shown below. Prime drip chamber and pump by hand.



4. Press the START/STOP key. Set the Blood Pump Speed to 30 using the DOWN ARROW key. Verify the ACD Ratio is 10. If it is not, adjust using the YES/NO Keys. Press START/STOP key.
5. Start the test by pressing the START/STOP Key. When the Pumps have achieved the desired speed, start the stopwatch and note the initial Drip Monitor reading under the Pump Speed column.

Note: **Start the stopwatch immediately after a screen update of Drip Monitor; update interval is approximately 4 seconds.**

6. Also check that, while running this test, the Drip Monitor's indicator LED flashes once per drop.
7. After *one* (1) minute, stop the pumps using the START/STOP Key. Note the final Drip Monitor reading. The difference between the Final reading and the Initial reading must be 54 +/- 10 counts.
8. Press the START/STOP key. Set the Blood Pump Speed to 120 using the UP/ARROW key. Verify the ACD Ratio is 10. If it is not, adjust using the YES/NO Keys. Press START/STOP key.
9. Start the test by pressing the START/STOP Key. When the Pumps have achieved the desired speed, start the stopwatch and note the initial Drip Monitor reading under the Pump Speed column.

Note: **Start the stopwatch immediately after a screen update of Drip Monitor; update interval is approximately 4 seconds.**

10. After *one* (1) minute stop the pumps using the START/STOP Key. Note the final Drip Monitor reading. The difference between the Final reading and the Initial reading must be 216 +/- 40 counts. Remove the drip monitor test harness.
11. Remove the fluid-filled tubing from the air detectors and then press the STOP key to exit.

Valves

1. Use the MODIFY key to highlight DIAGNOSTICS.
2. Use the MODIFY key to highlight VALVES and then press the DRAW key.
3. Verify that the LED on each pinch valve is "on."
4. Starting with the PURPLE valve, install a length of IV tubing through the valve. Attach one end of the tubing to a "T" Fitting. Attach a length of tubing to the other two ends of the "T" fitting. Attach a pressure bulb to one end and the Bio-Tek Universal Pressure Meter (or equivalent) to the other end. Press the RETURN key to close the valve, pressurize the bulb to **200 mmHg** and verify no leakage is evident by a decrease in pressure. Press the DRAW key to open the valve and remove the tubing.
5. Check the remaining valves. Use the MODIFY key to select the remaining valves.
6. Cycle valves with tubing installed to verify that all valves open/close freely and that no errors are generated. Press the STOP key to return to the DIAGNOSTIC menu.

Safety System Pressure Test

1. Use the MODIFY key to highlight SAFETY and then press DRAW.
2. Press DRAW to select PRESSURE.
3. Verify the DPM and SPM normal values are between **1920** and **2194**.
4. Press MODIFY to select the low pressure values and verify they are between **1265** and **1620.**
5. Press MODIFY to select the high pressure values and verify they are between **3260** and **4080.**
6. Press STOP to exit.

Weigher Test

1. Use the MODIFY key to highlight WEIGHER and then press DRAW.
2. Hang the following weights on the weigher arm and verify the readings are within specification.

Table 4-2: Weigher Specifications

Weight (grams)	Readings
100	100 +/- 3
500	500 +/- 5
1000	1000 +/- 10

3. With all weight removed, verify that the zero reading returns to **0 +/- 1.**
4. Press STOP to exit.

DPM/SPM Pressure Test

1. Use MODIFY to highlight PRESSURE and then press DRAW.
2. Attach the pressure monitor test harness to the DPM Sensor and connect a pressure meter, Bio-Tek Model DPM-11 (or equivalent), to the tubing. Set the meter to the mmHg scale. Increase the pressure until the pressure meter reads **100 +/- 1** mmHg. Verify that the DPM PRESSURE reading is **100 +/- 5**.
3. Repeat the test for the SPM Sensor.

DPM/SPM Interlock Test

1. Turn the DPM luer plunger clockwise and slide in. Verify that switches 1 and 2 of the DPM change from “OPENED” to “CLOSED.” Release and verify both switches on the screen return to “OPENED.”
2. Turn the DPM luer plunger counterclockwise and slide in. Verify that switches 1 and 2 of the DPM change from “OPENED” to “CLOSED.”
3. Release and verify both switches on the screen return to “OPENED.”
4. Turn the SPM luer plunger clockwise and slide in. Verify that switches 1 and 2 of the SPM change from “OPENED” to “CLOSED.”
5. Release and verify both switches on the screen return to “OPENED.”
6. Turn the SPM luer plunger counterclockwise and slide in. Verify that switches 1 and 2 of the SPM change from “OPENED” to “CLOSED.”
7. Release and verify both switches on the screen return to “OPENED.”
8. Press STOP to exit.

Display (Optional if noted during POST)

1. Use MODIFY to highlight DISPLAY and then press DRAW.
2. Verify all pixels are lit on the display.
3. Press STOP to exit.

Keyboard

1. Use the MODIFY key to highlight KEYBOARD and then press the DRAW key.
2. Press each of the keys. Verify that as each key is pressed, the LED on the key lights up (if the key has an LED) and the following is displayed on the screen:

Note: **The UP and DOWN ARROW and YES and NO keys do not beep.**

Table 4-3: Keyboard Calibrations

Key	Display
Prime	PRIME
Draw	DRAW
Return	RETURN
Pump up	UP ARROW
Pump Start/Stop	START/STOP
Pump down	DOWN ARROW
Cuff	CUFF
Modify	MODIFY
Save	SAVE
Help	HELP
Yes	YES
No	NO

3. Press the STOP key to exit.

Centrifuge, Vacuum

Cover

1. Use the MODIFY key to highlight CENTRIFUGE and then press DRAW.
2. Close the centrifuge cover and verify the Centrifuge Relay and Centrifuge Cover indicate CLOSED. Verify the knob turns **3/8 to 5/8** more after the Centrifuge Cover indicates CLOSED. Open the centrifuge cover and verify the switches indicate OPENED.

Vacuum/Speed

1. Attach the vacuum test tubing between the quick disconnects of the centrifuge and vacuum and attach the pressure meter to the tubing. Set the meter to the **-13.5** to **15** psi scale. Place a bowl (half filled with water) into the centrifuge, (press down lightly on the bowl) close and lock centrifuge cover. Verify the reading is **-10** to **-13.5** psi.
2. Press the DRAW key to start the centrifuge.
3. When the Centrifuge Speed stabilizes at **4800 +/- 30**, note the centrifuge speed. Press the PRIME key to turn vacuum pump off. After **1** minute the pressure must not decrease by more than **2** psi from the initial reading.
4. Press the RETURN key to stop the centrifuge.

Dump Valve

1. Press the CUFF key to open the dump valve and verify that the pressure meter reading drops to **0+/-1** psi.
2. Remove the vacuum test tubing and pressure meter and reconnect the centrifuge and vacuum disconnects.

Centrifuge, Mechanical

Cover

1. Use the MODIFY key to highlight CENTRIFUGE and then press DRAW.
2. Close the centrifuge cover and verify the Centrifuge Relay and Centrifuge Cover indicate CLOSED. Open the centrifuge cover and verify the switches indicate OPENED.

Speed

1. Close and lock the centrifuge cover.
2. Press the DRAW key to start the centrifuge.
3. Verify that the Centrifuge Speed stabilizes at **4800 +/- 30**.
4. Press the RETURN key to stop the centrifuge.

Fluid Sensor Test

1. Open the centrifuge cover and touch the fluid sensor with the moistened end of a cotton swab and verify the SPILL DETECTOR indicates TRUE.
2. Dry the fluid sensor and verify that the display indicates FALSE.
3. Press STOP to exit.

Donor Lights

1. Use the MODIFY key to highlight DONOR LIGHTS and then press DRAW.
2. Ensure that the LEDs on all four sets of donor lights are ALL ON.

Note: **Four donor light set locations are: Left Handle, Right Handle, Front Panel, Rear of Top Cover.**

3. Press the MODIFY key. Ensure that the screen and the LEDs on all four sets of donor lights are ALL OFF.
4. Press the MODIFY key. Ensure that the screen and the LEDs on all four sets of donor lights indicate NORMAL FLOW (GREEN).
5. Press the MODIFY key. Ensure that the screen and the LEDs on all four sets of donor lights indicate LOW FLOW (YELLOW).
6. Press the MODIFY key. Ensure that the screen and the LEDs on all four sets of donor lights indicate NO FLOW (RED).
7. Press the MODIFY key. Ensure that the screen and the LEDs on all four sets of donor lights indicate RETURN FLOW (YELLOW).
8. Press the STOP key to exit.

Transducers

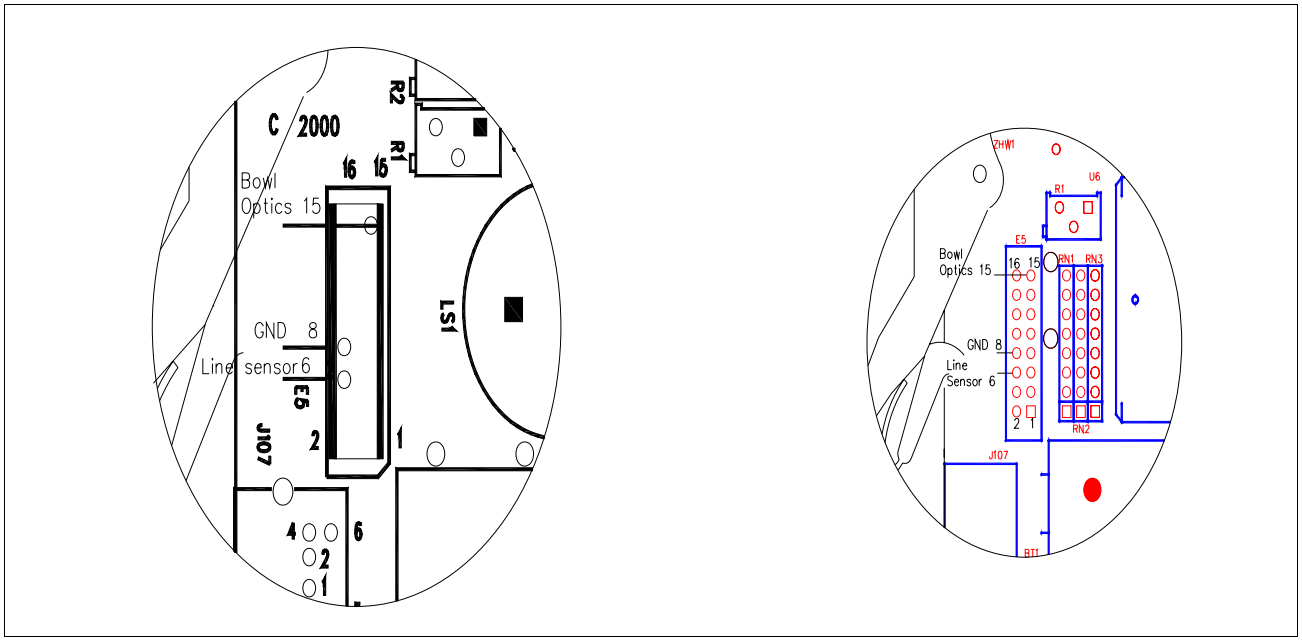


Figure 3-1, Test points for processor boards 50846-01 (left) and 39783-00 (right)

Test points for the line sensor signal and the bowl optics signal:

- Ground: E5 pin 8
- Line sensor: E5 pin 6
- Bowl optics: E5 pin 15

Line Sensor

1. Use the MODIFY key to highlight TRANSDUCERS and then press DRAW.
2. Measure the value of the clear voltage. Verify that the clear voltage is **3.75 +/-0.25** volts or **3071** digital. Verify that the displayed digital LINE SENSOR value is between **2866** and **3276**.
3. Slide a black shim between the LED and sensor head of the line sensor. Verify that the black voltage is **> - 0.25** V and **<0.13** V (1-103 Digital).

Note: **Regarding digital values - 0 (zero) is not valid as it can be any negative voltage and as such only numbers above 0 may be used.**

Optics

Note: **For MECHANICAL Chuck Centrifuge only; rotate the centrifuge chuck until the optics beam IS NOT aiming toward any of the mechanical fingers.**

4. Verify the offset voltage is within the range of **-0.03 to +0.07** volts (**1 - 57**).

Note: **The Kodak photographic gray card used in the optics fixture (#ETE-5007) must be uncontaminated by light or material. Install a fresh gray card (P/N 38372-00) if the initial reading is out of specification to verify that the difference is not due to the gray card.**

5. Place the optics aiming fixture #ETE-5007 into centrifuge and rotate until the optics spot hits the gray card on the fixture. Then rotate the fixture slightly until the peak voltage or displayed reading is obtained; verify the voltage is **+2.8 to 4.0** volts (**2295 -3278**).

Corrected Optics Voltage = Actual Optic Gray Card Reading (Vdc) / Corrective Factor

Or

Corrected Optics Digital Value = Actual Digital Gray Card Reading / Corrective Factor

6. Refer to the calibration section of this chapter if the Line Sensor or Optics are not within specification.
7. Press the STOP key to exit.

Bowl Optic Calibration (eight valve machine)

For information on the 7 valve machine see Bowl Optics Signal (seven valve machine) on page 4-19.

Voltage Check

1. Attach Optics test harness to E5 on the CPU Board and the voltmeter, set to DC volts.
2. Record the corrective factor written on the base of the optics aiming fixture #ETE 5379-00.
3. Set the optics aiming fixture #ETE 5379-00 into the centrifuge and rotate the fixture until the optics beam is in the center of the gray card.
4. Using formula below, determine the corrected optic gain being measured by dividing the actual optic gray card reading by the Corrective Factor denoted below.

Corrected Optics Voltage = Actual Optic Gray Card Reading (Vdc) / Corrective Factor

Or

Corrected Optics Digital Value = Actual Digital Gray Card Reading / Corrective Factor

The corrected optics voltage should be between 2.8 and 4 volts (digital value between 2295 and 3278).

5. Remove the optics aiming fixture #ETE 5379-00 from the centrifuge.
6. Rotate the centrifuge chuck to ensure the optics beam is not hitting one of the mechanical chuck fingers.
7. The offset reading value must be between +.00 and +.04 volts (offset). Note this value.

Bowl Optics Aiming Check

1. With a pen, make a mark inside the centrifuge on the chuck edge (this mark should be visible with the fixture in place).
2. Seat the optics alignment fixture #ETE 5379-00 inside the centrifuge, the ì0î on the optics fixture (ETE 5379-00) should be aligned with the mark on the chuck.
3. For vacuum centrifuges, press PRIME key in order to start the vacuum pump.
4. Rotate the optics fixture (ETE 5379-00) slowly back and forth until you reach the minimum voltage reading with an accuracy of .01 Vdc. Turn the indicator of the fixture only, until the optics beam is in the center of the mark. Then, record the corresponding aiming volume from the graduated disk.
5. Repeat measurement two more times by doing the following:
   a. Remove the optics fixture. (for vacuum centrifuges press PRIME key to stop the vacuum pump and press the dump valve button to release the vacuum).
   b. Rotate the optics fixture by a 120-degree angle (clockwise) from the reference mark (by aligning 120 and then 240 from the fixture to the reference mark).
   c. Reinstall the fixture into the centrifuge repeat step 0 for 120 and 240 positions.
   d. Calculate the average of the three measurements. This final value (aiming volume) must be equal to **42 ml ± 1 ml for a vacuum centrifuge with L-Gasket and 40 ml ± 1 ml for a mechanical centrifuge.**
5. Remove all optics test harness fixtures.
6. Power OFF the unit.

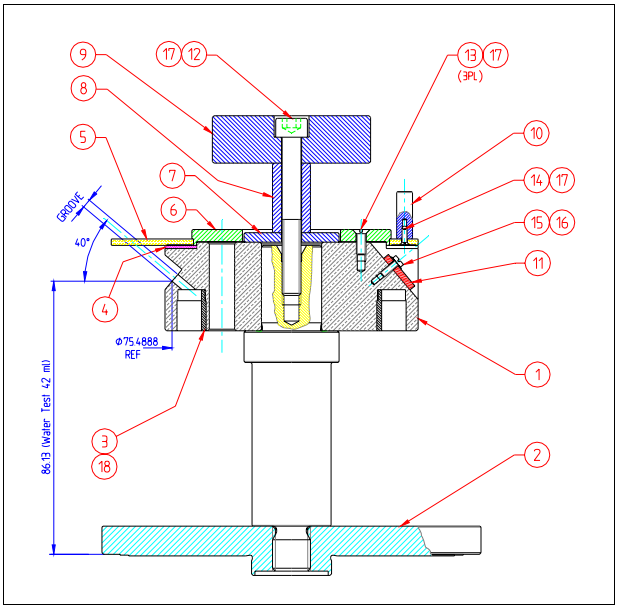


Figure 3-2, Bowl optics voltage and aiming check

Air Detectors

1. Use the MODIFY key to highlight AIR DETECTORS and then press DRAW.
2. Install water-filled tubing in the Anticoagulant Air Detector and confirm that the **STATUS** displays **FLUID** and the Anticoagulant Air Detector LED is illuminated. Remove the tubing from the Anticoagulant Air Detector and confirm that **STATUS** displays **AIR**.
3. Repeat this procedure for the Blood Line Air Detector, Donor Line Air Detector 1, and Donor Line Air Detector 2.
4. If an air detector fails the testing, refer to the Troubleshooting chapter.
5. Press the STOP key to exit.

Disposable ID Test (optional - as needed)

1. Use the MODIFY KEY to highlight DISPOSABLE ID and then press DRAW.
2. With nothing on the bar code reader, verify that the RAW DATA value display on the screen is FF and the DISPOSABLE ID value is 3F.
3. Place disposable ID test fixture #ETD-5155-1 (37635-00) (all white) onto the bar code reader. Verify that the RAW DATA value display on the screen is 0 and DISPOSABLE ID value is 0 (all white).
4. Remove disposable ID test fixture #ETD-5155-1 (37635-00) and place disposable ID test fixture #ETD-5155-2 (48543-00) (black/white/black) onto the bar code reader. Verify that the RAW DATA value display on the screen is 2A and the DISPOSABLE ID value is 15 (black-white-black).
5. Remove disposable ID test fixture ETD-5155-2 (48543-00) and place disposable ID test fixture #ETD-5155-3 (49428-00) (white/black/white) onto the bar code reader. Verify that the RAW DATA value display on the screen is 54 and the DISPOSABLE ID value is 2A (white-black-white). Remove disposable ID test fixture #ETD-5155-3 (49428-00) from the bar code reader.
6. Press the STOP key to exit.

Network (optional, seven valve machine only)

Note: **Use a laptop PC to complete this step.**

1. Power on the PC.

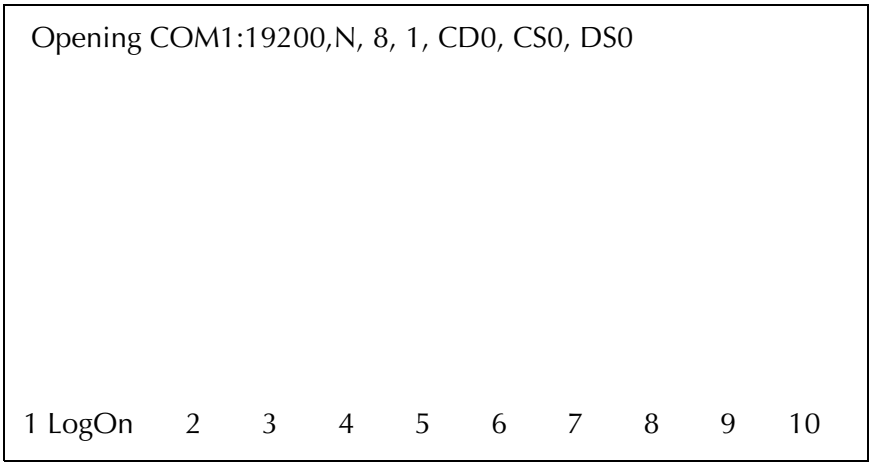
Note: **If "DHHOST.EXE" test program, P/N 47221-00, is not installed on the test PC, perform the following before proceeding to Step 2: Insert the test program diskette, P/N 47220-00, into the 3.5" disk drive A. At DOS prompt C:, type MD DHHOST and then press ENTER. At DOS prompt C: type COPY A:.EXE C:, Press ENTER.**

Note: **Once the "DHHOST.EXE" test program is installed in the directory "DHHOST" in the test PC, perform the following;**

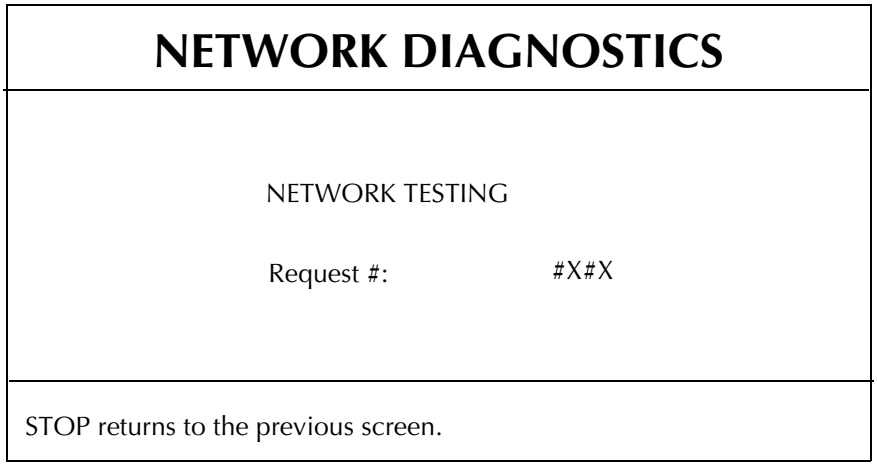
2. Remove the RS232 port cover.
3. Connect the 9 pin male connector of the Null Modem Adapter to the 9 pin female connector of the serial RS-232 cable.
4. Using the RS-232 cable, connect the RS-232 port of the MCS+ machine to the serial port COM1 connector on the back of the computer.

Note: **If computer has more than one COM port, ensure that the COM1 is connected.**

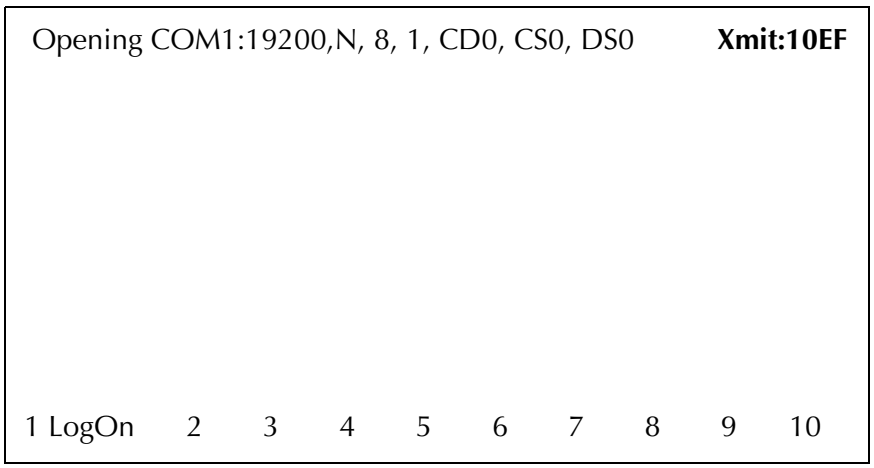
5. At DOS prompt C:, type CD DHHOST and then press ENTER.
6. Type DHHOST, and then press ENTER. Observe the following COM port opening parameters on the PC screen.



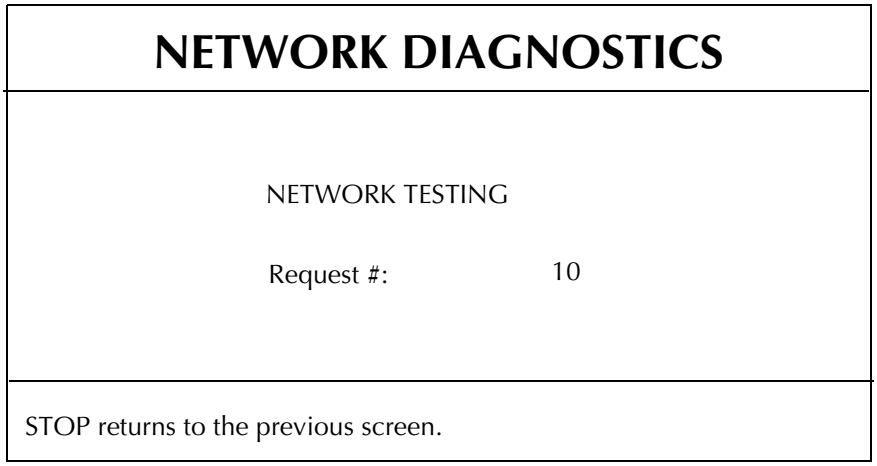
7. Press the MODIFY key on the MCS+ machine to highlight NETWORK and then press the DRAW key and confirm that the following display appears:



8. Press <F1> key to send the data request from the PC to the MCS+. The following display appears:



9. Verify that the following information is displayed on the MCS+ screen:



10. Press STOP twice to exit.

Cycle Test (optional - can be used for Functional Test)

1. Install water-filled tubing into the four MCS+ air detectors.
2. Install filters onto the MCS+ DPM and SPM.
3. Install Disposable ID Test Fixture ETD 5155-1 (37635-00) (all white) onto the MCS+ Disposable ID reader.
4. Install an empty Latham bowl into the MCS+ Centrifuge. Close and lock the centrifuge cover.
5. Power the MCS+ machine on.
6. The machine will now cycle through the POST, Power On System Tests.

   Confirm that when the Load Disposable screen is displayed, all disposable requirements are satisfied automatically. If the Load Disposable screen remains displayed and the vacuum pump is running, the bowl installed in the centrifuge cannot be used for this test. Replace the bowl.

7. The cycling program will now proceed with the following steps:
   a. The Autoload screen will be displayed, and all 3 pumps will turn approximately 4 revolutions.
   b. The Priming screen will be displayed for approximately 40 blood pump revolutions.
   c. The Draw screen will be displayed until approximately 300 ml have been processed. The cycle counter will display 0 or 1.
   d. The Dwell screen will be displayed for approximately 30 seconds.
   e. The Surge screen will be displayed until the pump flow rate peaks at 200 ml/min., and then drops back down to zero.
   f. The Centrifuge Braking screen, with safety board information, will be displayed while the centrifuge brakes to a stop.
   g. The Return screen will be displayed for approximately 1 minute.
   h. The entire cycle will take approximately 8 minutes and 15 seconds.
   i. The machine will perform a warm reboot, and cycling will begin again. The cycle counter will increment from the initial number by one each cycle.
8. Test for up to 16 hours or on an as needed basis.

Note: **If any errors occur during the cycle test:**

1. Note the error message displayed on the screen.
2. Identify and resolve the problem using the information provided in Chapter 6.
3. Power the MCS+ off, and then back on again.
4. Cycling will resume from the last cycle number displayed.

Calibration Procedures

Setup

1. Install the DIAGNOSTIC protocol card (P/N 47536-00) into the smart card reader.
2. Fully extend the weigher arm.
3. Attach the Optics/Line Sensor Test cable fixture #ETC-5156 to the CPU PCB (not necessary if using digital values).

Refer to disassembly on pages 5-2 and 5-3 for removing the Front and Rear panels.

Power Supply

1. Power on the LN 9000.
2. Using a Voltage Meter, Fluke 21 or equivalent, set to DC volts, measure and note the power supply output voltages verifying that the voltages are within the specifications provided below.
3. Test points are all on the Advanced Personality PCB assembly on the rear of the card cage. Test points are located on the upper left hand side and are labeled left to right (TP6, TP1, TP2, TP3, TP4, TP5).

4. Use TP6 for system ground.

Voltage (VDC)	Location
5.1 +0.1/-0	TP pin 1
15 +/ -0.4	TP pin 2
-15 +/- 0.4	TP pin 3
28.375 +/- 1.5	TP pin 4
48.650 +/- 2.5	TP pin 5

Power Supply I

1. If the 5V supply needs adjustment, place the leads on the 5 volt pins and adjust the 5 volt supply trimpot (R22) on the power supply. The power supply must be removed from the brackets and machine to access the 5 volt potentiometer. Use an insulated screwdriver through the access hole to make any adjustments.
2. After adjustment verify all other supplies are within specification.

Power Supply II

1. If the 5V supply needs adjustment, place the leads on the 5 volt pins and adjust the 5 volt ADJ trimpot on the back of the power supply.
2. After adjustment verify all other supplies are within specification.

Line Sensor

1. Power on the LN 9000. After POST test press and release the STOP key to enter Utilities.
2. Use the MODIFY key to highlight DIAGNOSTICS and then press DRAW.
3. Use the MODIFY key to highlight TRANSDUCERS and then press DRAW.
4. Attach a Voltage Meter, Fluke 21 or equivalent, set to DC volts to the Optics/ Line Sensor Test cable fixture #ETC-5156.
5. Ensure the Line Sensor cover is DOWN. Remove the black access plug located on the front panel of the line sensor.
6. Use a trim pot adjustment tool to set the line sensor signal to between 2866 – 3276 (3.75 $\pm$ 0.25 VDC).
7. Slide a black shim between the LED and sensor head of the line sensor. Verify that the black voltage is **> - 0.25** V and **<0.13** V **(1 - 103).**
8. Adjust as necessary to satisfy both ranges.
9. Replace the black access plug in the line sensor.
10. Press STOP to exit.

Bowl Optics Signal (seven valve machine)

For information on the 8 valve machine see Bowl Optic Calibration (eight valve machine) on page 4-13.

1. Refer to *Setup* on page 4-18 at the beginning of the calibration section.
2. Power to the LN 9000 must have been on continuously for at least 15 minutes before proceeding.
3. Use the MODIFY key to highlight DIAGNOSTICS and then press DRAW.

4. Use the MODIFY key to highlight TRANSDUCERS and then press DRAW.
5. Attach a Voltage Meter, Fluke 21 or equivalent, set to DC volts measuring to 2500 counts minimum (better than 3 1/2 digits) to the Optics/ Line Sensor Test cable fixture #ETC-5156.
6. Inspect the optic window for contamination of blood or dirt and clean with a damp lint-free cloth before measuring voltage.

Note: **The Kodak photographic gray card used in the optics fixture (#ETE-5007 [7 valve device]) must be new and uncontaminated by light or material. Install a fresh gray card (P/N 38371-00) immediately before using the fixture. Then remove and discard after all testing is complete.**

Corrected Optics Voltage = Actual Optic Gray Card Reading (Vdc) / Corrective Factor

Or

Corrected Optics Digital Value = Actual Digital Gray Card Reading / Corrective Factor

7. Place the optics aiming fixture #ETE-5007 into the centrifuge and rotate until the optics beam is reflecting on the rim of the fixture. **IMPORTANT**: *The spot must be on a section of the rim that is free from nicks and scratches.* If the optic beam is not centered on the rim, loosen, but leave snug, the (4) 4-40 keps nuts that secure the optic aiming module mounted to the centrifuge.
8. Slide the optics assembly up or down so the optic beam projects on the rim portion of the optics alignment fixture. Remove the cover on the photoelectric transceiver and adjust the gain on the banner optics until the meter displays 2.500 +/-0.5 volts.

Note: **Peaking must be done to three places to the right of the decimal.**

9. Push the optics assembly down, until the meter drops below peak by approximately 0.2 volts, and then tighten the nuts until the optics assembly can not be moved by hand. Use optics adjusting fixture #ETB-5266 placed under the optics assembly, between the optics assembly and the cut-out in the centrifuge. Slowly move the optics assembly up until a peak reading is achieved, noted by a decrease in voltage that is less than .010 volts of the peak value.
10. With the optics adjusting fixture #ETB-5266 under the optics assembly, tighten the #4-40 keps nuts securely in a diagonal order (ex: top left, bottom right, top right, bottom left), noting that the optics assembly should not move a noticeable amount. Remove the optics adjusting fixture #ETB-5266.
11. Rotate the optics alignment fixture #ETE-5007 inside the centrifuge so that the beam reflects on the circle on the rim of the fixture and verify that the beam is touching the center of the circle. (The beam must not fall outside the outer circle.)
12. Rotate the fixture until the optic beam is on the gray card. Rotate the fixture slowly until a peak analog optics value (gain) is displayed on the voltmeter. Adjust the gain to +3.53 $\pm$ 0.03 VDC.
13. Remove the optics fixture from the centrifuge. Adjust R2 potentiometer on the CPU PCB until the analog optics value (offset) is +0.03 $\pm$ 0.02 VDC.
14. Replace the optics fixture and locate the peak gray card optics value. Adjust the optic gain on the photoelectric transceiver until the analog optics value is +3.53 $\pm$ 0.03 VDC.

Note: **For MECHANICAL Chuck Centrifuge only: rotate the centrifuge chuck until the optics beam IS NOT aiming towards any of the mechanical fingers.**

15. Repeat the (offset) and (gain) tests until both are within specification. Apply glyptol to R2 on the CPU board.
16. Press STOP to exit.

Bowl Optics Final Calibration (seven and eight valve machines)

1. Attach Optics Test harness fixture #ETB-5157 to Optics/ Line Sensor Test cable fixture #ETC-5156 and plug into E5 on the CPU Board and the voltmeter, set to DC volts.
2. Adjust R1 on the CPU Board until an (offset) reading of **+.03+/-.02** volts (average) is achieved without anything in the centrifuge.
3. Using formula below, determine the photoelectric gain to be adjusted by multiplying the Corrective Factor (previously recorded at step 6.7) by the unit calibration value (3.53 Vdc).

Voltage to be adjusted = Corrective Factor x Unit Calibration Value (Vdc)
Voltage to be adjusted = Corrective Factor x 3.53 (Vdc)

4. Record the calculated voltage to be adjusted.
5. Place optics aiming fixture #ETE-5007, or #ETE 5379-00 for 8 valve machines, into centrifuge and rotate until the optics spot hits approximately in the gray card center on the fixture., then adjust the photoelectric assy's gain pot until the calculated voltage to be adjusted ± 0.05 Vdc is achieved.
6. Repeat the above steps until both the gain and offset are within the above specified ranges.
7. Record final grey and offset voltages.
8. Apply glyptol (Item 51) to R1 on the cpu board.
9. Reinstall the cover on the photoelectric assembly.
10. Remove the optics aiming fixture #ETE-5007, or ETE 5379-00 for 8 valve machines, from the centrifuge.
11. Remove the gray card from optics aiming fixture #ETE-5007 and place it in the Gray Card Replacement Kit envelope.

A/D

Cuff

1. Refer to *Setup* on page 4-18 at the beginning of the calibration section.
2. Power on the LN 9000. After POST test, press the STOP key to enter Utilities.
3. Use the MODIFY key to highlight CALIBRATION and then press DRAW.
4. Use the MODIFY key to highlight A/D and then press DRAW.
5. Use the MODIFY key to highlight CUFF.
6. Press the DRAW key to store the CUFF OFFSET value.

7. Attach the cuff adapter tubing to the quick disconnect on the rear panel and connect a pressure meter, Bio-Tek Model DPM-11 (or equivalent) to the tubing. Set the meter to the mmHg scale and then press the CUFF key to start the compressor. (Note: if the DAC value is greater than 255, reset by pressing the "+" key). Increase (using the **"+"** key) or decrease (using the **"-"** key) until the pressure meter reads **100 +/- 1** mmHg. Press the RETURN key to store the CUFF FULL SCALE value. Press the CUFF key to stop the compressor and then disconnect the pressure meter and adapter tubing from the rear panel.
8. Press the STOP key twice to exit.

Weigher

1. Refer to *Setup* on page 4-18 at the beginning of the calibration section.
2. Power on the LN 9000. After POST test, press the STOP key to enter Utilities.
3. Use the MODIFY key to highlight CALIBRATION and then press DRAW.
4. Use the MODIFY key to highlight A/D and then press DRAW.
5. Use the MODIFY key to highlight WEIGHER.
6. Press the DRAW key to store the WEIGHER OFFSET value.
7. Place a **1000** gram weight on the weigher arm assembly. Allow to stabilize and then press the RETURN key to store the WEIGHER FULL SCALE value. Remove the 1000 gram weight.
8. Press the STOP key twice to exit.

SPM

1. Refer to *Setup* on page 4-18 at the beginning of the calibration section.
2. Power on the LN 9000. After POST test, press the STOP key to enter Utilities.
3. Use the MODIFY key to highlight CALIBRATION and then press DRAW.
4. Use the MODIFY key to highlight A/D and then press DRAW.
5. Use the MODIFY key to highlight SPM.
6. Press the DRAW key to store the SPM OFFSET value.
7. Attach the pressure monitor test harness to the SPM Sensor and connect a pressure meter, Bio-Tek Model DPM-11 (or equivalent) to the tubing. Set the meter to the mmHg scale. Increase the pressure until the pressure meter reads **300 +/- 2** mmHg. Press the RETURN key to store the SPM FULL SCALE value. Remove the pressure meter and test harness.
8. Press the STOP key twice to exit.

DPM

1. Refer to *Setup* on page 4-18 at the beginning of the calibration section.
2. Power on the LN 9000. After POST test, press the STOP key to enter Utilities.
3. Use the MODIFY key to highlight CALIBRATION and then press DRAW.
4. Use the MODIFY key to highlight A/D and then press DRAW.
5. Use the MODIFY key to highlight DPM.
6. Press the DRAW key to store the DPM OFFSET value.

7. Attach the pressure monitor test harness to the DPM Sensor and connect a pressure meter, Bio-Tek Model DPM-11 (or equivalent) to the tubing. Set the meter to the mmHg scale. Increase the pressure until the pressure meter reads **300 +/- 2** mmHg. Press the RETURN key to store the DPM FULL SCALE value. Remove the pressure meter and test harness.
8. Press the STOP key twice to exit.

Centrifuge, Vacuum

1. Refer to *Setup* on page 4-18 at the beginning of the calibration section.
2. Power on the LN 9000. After POST test, press the STOP key to enter Utilities.
3. Use the MODIFY key to highlight CALIBRATION and then press DRAW.
4. Use the MODIFY key to highlight CENTRIFUGE and then press DRAW.
5. Place a bowl (half filled with water) into the centrifuge; close and lock the centrifuge cover.

Note: **Press down lightly on the bowl when installing.**

6. Verify the screen now displays VACUUM = TRUE.
7. Press the DRAW key and the centrifuge will start, increase (using the **"+"** key) or decrease (using the **"-"** key) the OUTVAL until the actual speed reads **7000 +/- 30** RPM.
8. Press the MODIFY key, which will select 3000. Increase (using the **"+"** key) or decrease (using the **"-"** key) the OUTVAL until the actual speed reads **3000 +/- 30** RPM.
9. Press the SAVE key to store the values.
10. Press the STOP key twice to exit.

Centrifuge, Mechanical

1. Refer to *Setup* on page 4-18 at the beginning of the calibration section.
2. Power on the LN 9000. After POST test, press the STOP key to enter Utilities.
3. Use the MODIFY key to highlight CALIBRATION and then press DRAW.
4. Use the MODIFY key to highlight CENTRIFUGE and then press DRAW.
5. Place a bowl (half filled with water) into the centrifuge; close and lock the centrifuge cover.

Note: **Press down on the bowl when installing into the mechanical centrifuge.**

6. Press the DRAW key and the centrifuge will start, increase (using the **"+"** key) or decrease (using the **"-"** key) the OUTVAL until the actual speed reads **7000 +/- 30** RPM.
7. Press the MODIFY key, which will select 3000. Increase (using the **"+"** key) or decrease (using the **"-"** key) the OUTVAL until the actual speed reads **3000 +/- 30** RPM.
8. Press the SAVE key to store the values.
9. Press the STOP key twice to exit.

Serial Number

1. Refer to *Setup* on page 4-18 at the beginning of the calibration section.
2. Power on the LN 9000. After POST test press and release the STOP key to enter Utilities.
3. Use the MODIFY key to highlight CALIBRATION and then press DRAW. Switch on the CPU PCB when indicated.

4. Use the MODIFY key to highlight SERIAL NUMBER and then press DRAW.
5. Enter the 2 digits for the year using the "+" key to increase and the "–" key to decrease.
6. Use the MODIFY key to select LETTER. Enter the single letter representing the month using the "+" key to increase and the "–" key to decrease.
7. Press the MODIFY key to select NUMBER. Enter the three digits for the machine number using the "+" key to increase and the "–" key to decrease.
8. Press the SAVE key to store the serial number. Verify that the values displayed on the screen for Current Serial Number and Updated Serial Number are the same.
9. Press the STOP key twice to exit.

Ground Continuity

1. Plug the meter into a wall outlet and the equipment to be tested.
2. Set the meter mode to *Resistance*.
3. Attach the grounding clip to the following exposed metal locations. Verify that there is continuity. Record the highest reading on the service report.
   a. Rear panel hardware
   b. Centrifuge cover hinge
   c. Front panel hardware
   d. Pinch valve levers

Note: **Continuity – Less than 1 ohm and recorded in milliohms on the Field Service Report. For example – [.35 ohms = 350 milliohms]**

Leakage Current

1. Plug the meter into a wall outlet and the equipment to be tested.
2. Turn on the equipment being tested.
3. Set the meter switch settings as follows:
   a. Leakage
   b. Neutral Closed
   c. Polarity Normal

Note the reading on the meter – depress the GND switch – this will open the ground connection. Change the "Polarity" switch from *Normal* to *Reverse*. Record the highest reading. This is the quantity of microamperes that are "leaking" under these electrical conditions.

Verify that this reading does not exceed the labeled limit that can be found on the overlay attached to the rear panel of the machine. *This "limit" is dependent upon the specific supply being tested and may vary.*

Note: **The steps above will constitute a "single fault" condition that replicates the conditions tested in Manufacturing. Any deviation from this method should be noted if documented onto the service report. Only this "single fault" condition should be entered in the corresponding field on the Field Service Report. Any other fault conditions will be noted in the "Field Service Engineer's Observations and Actions" section of the Field Service Report.**

Functional Test

This procedure is designed to ensure that all aspects of the machine are able to function. It does not replace any tests that are associated with calibrations. The functional test is meant to verify that all components have been restored to operational status and that no inadvertent malfunction has been created during the course of a repair or preventive maintenance call.

Materials Required

DPM / SPM filter

Fluid-filled tubing

Bowl (optional)

Manifold for Disposable ID Reader

SDP/PLP protocol card (or equivalent)

BP cuff assembly

Procedure

At the Load Disposable screen, install the appropriate items and verify that the corresponding prompt disappears, indicating the machine's acknowledgement of its presence. A bowl is not required when a mechanical chuck is used. Simply pass a light-colored object (e.g. white paper) in front of the optics at a distance of approximately two inches. This will cause a sufficient change in the optic's offset. This is how the machine determines the presence of a bowl. If a vacuum centrifuge is being used, a bowl must be used so that the vacuum circuit will be satisfied.

A final line on the display asks whether the tubing is in the line sensor. Press YES which brings up the HaemoCalculator screen or floss tubing through the line sensor. Press STOP to access the Ready screen.

Load the fluid-filled tubing into all four of the air detectors and verify that all detectors' lights are on signifying that they now sense fluid.

Press CUFF and verify that the cuff inflates.

Press PRIME and verify the following: When the PRIME button is pressed, the green and blue valves are opened and the white pump turns clockwise at 250 ml/min for up to 100 ml, or until the SPM pressure decreases to -15 mmHg to pump the air from the platelet bags to the plasma bag.

Press the DRAW key. Verify that the centrifuge comes up to speed, the AC and Blood Pumps start turning, and that the BP Cuff begins to inflate. After approximately 30 seconds, press STOP. This completes the functional test.

Disposal

Follow local standard operating procedure for the disposal of medical equipment when disposing of the device. If needed, contact the local Haemonetics representative for assistance.

Chapter 5
MCS+ Disassembly

Warning

To avoid electrical shock, extreme caution should be exercised when working inside the MCS+ cabinet. Avoid contact with AC power connections and any electrolytic capacitors, particularly on printed circuit boards (PCBs). Whenever possible, AC power should be disconnected from the MCS+ before opening the cabinet.

Static Discharge

The MCS+ uses static-sensitive electronics. **Serious damage may occur to the unit's electronic systems if static discharge is not controlled!** Internal components should only be handled after proper precautions have been taken to prevent static discharge.

Notes

The instructions in this chapter provide general guidelines for the most logical approach to disassembling the MCS+.

To reassemble the MCS+, reverse the disassembly steps. In some cases, reassembly notes have been added to direct your attention to any important steps.

Label or tag each line as you disconnect it so you can easily identify where it should be reconnected.

For brevity, a procedure will often reference another procedure. For instance, when removing the top deck, the instructions indicate you must first remove the centrifuge. Locate the centrifuge removal procedure for instructions on that particular step.

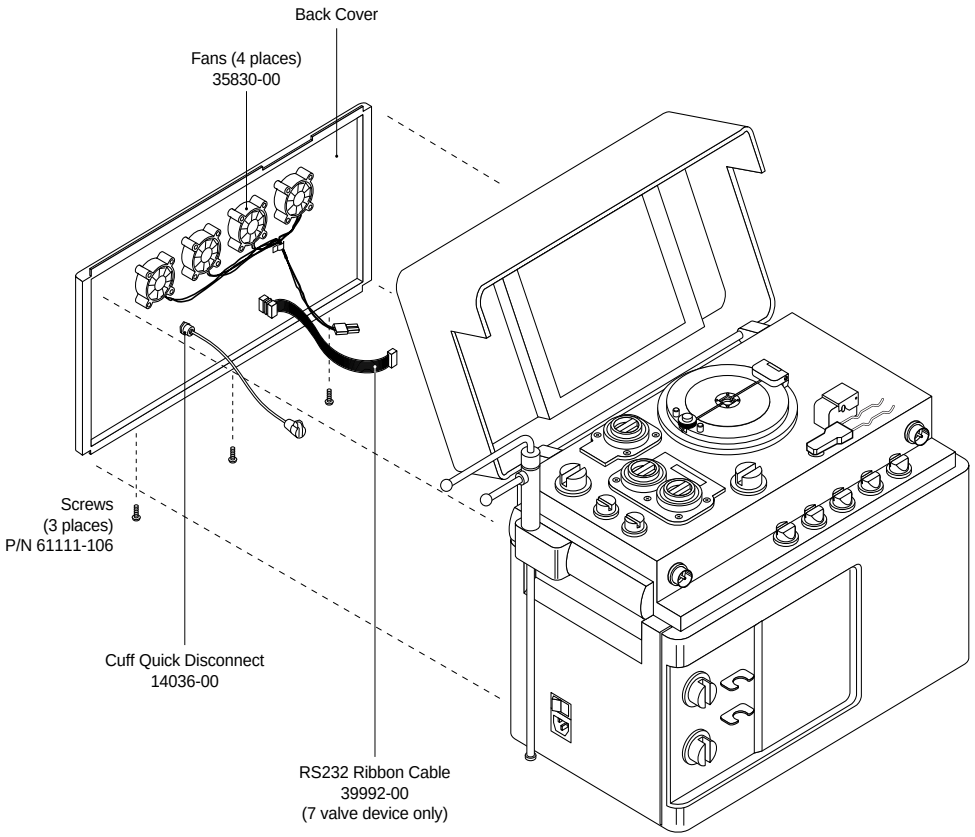


Figure 5-1, Rear Panel (note: seven valve device used as an example)

Rear Panel Disassembly

1. Remove the (3) Phillips head screws from the bottom edge of the rear panel.
2. Pull the bottom edge 6" away from the cabinet, then pull the rear panel down and away from the upper lip of the cabinet.
3. Unplug the fans.
4. Disconnect the cuff pneumatic line at the quick disconnect.
5. Remove the ground wire from the ground lug on the rear panel.
6. To remove the rear panel completely, disconnect the RS232 connector from the Advanced Processor PCB.

Fans

1. Remove the Rear Panel.
2. Remove the (2) nuts for each fan to be removed.
3. If removing less than all four fans, cut the wires so that they can be reconnected by using crimp style connectors.

Cover Stops

1. Remove the Rear Panel.
2. Remove the (2) Phillips head screws for each cover stop to be removed.

Cuff Quick Disconnect

1. Remove the Rear Panel.
2. Remove tubing from barbed end of the quick disconnect fitting.
3. Remove the nut securing the quick disconnect to the rear panel.
4. Push the connector out of the panel from the rear.

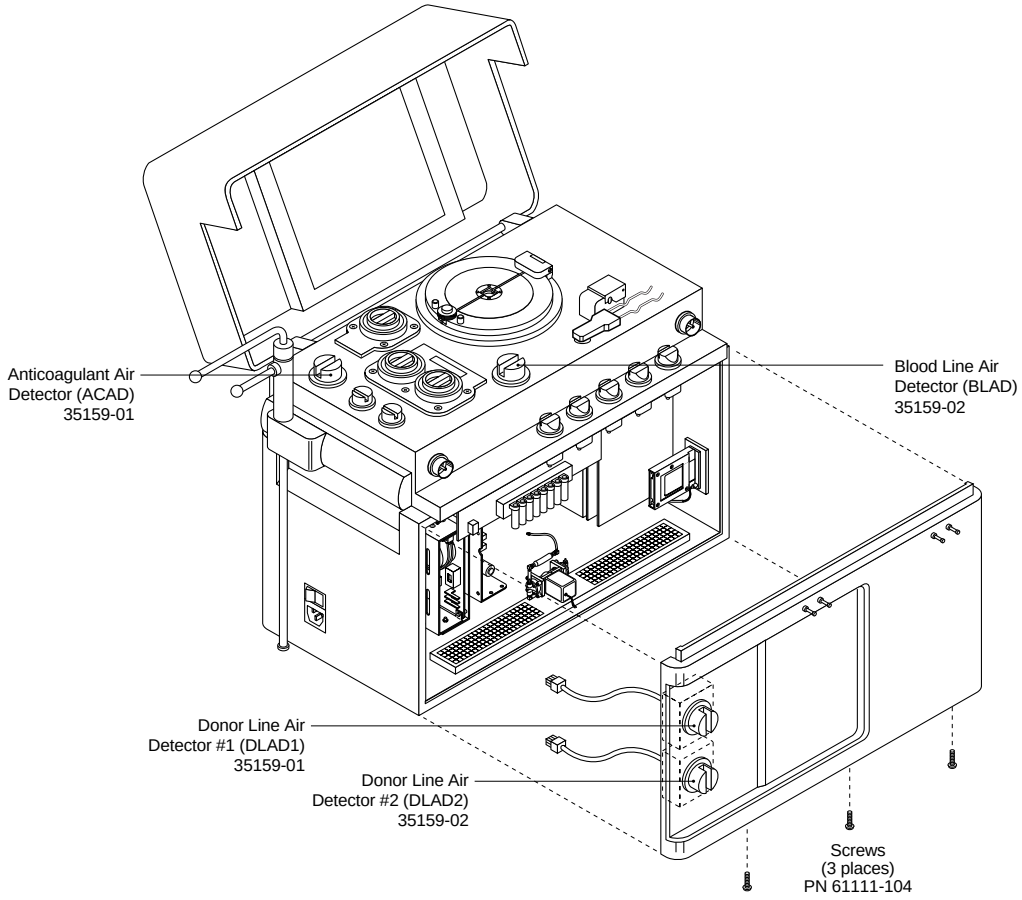


Figure 5-2, Front Panel (note: seven valve device used as an example)

Front Panel Disassembly

1. Tilt the cabinet back slightly and remove the (3) Phillips head screws from the bottom edge of the front panel.
2. Pull the panel down 1″ and away from the upper lip of the cabinet.
3. Disconnect air detector pins P506 and P607 from the Top Deck Distribution PCB.
4. Remove the (1) Phillips head screw which attaches the ground wire to the front panel.

Air Detectors (DLAD1 and DLAD2)

1. Remove the Front Panel.
2. Disconnect air detectors pins P506 and P607 from the Top Deck Distribution PCB.
3. Remove the (2) Phillips head screws from each air detector.

Note: Be aware of nylon spacers between air detector mounting holes and front panel.

4. Firmly press the air detector head (from the front) through the panel. This is normally a very tight fit; the detector may have been lubricated with silicone grease when assembled.

Front Panel Air Detector Reassembly

Air detector connectors are keyed to ensure proper location, but the air detectors themselves could accidentally be installed in the wrong location. The DLAD1 at P506 is located in the upper panel location, and the DLAD2 at P607 is located in the lower panel location.

When installing the air detector, be sure the gasket is in place in the panel, and lubricate the inner diameter of the gasket with silicone lubricant to ease the installation of the air detector head.

Filter Guide

1. Remove the Front Panel.
2. Remove the (2) Phillips head screws which secure each filter guide to the front cover.

Bag Hanger Pins

1. Remove the Front Panel.
2. Remove the metal pins using a 11/34″ nut driver.

Card Cage

1. Remove the Front and Rear Panels.
2. Remove the cards from the card cage.
3. Remove (4) Phillips head screws which secure the card cage frame to the cabinet base. (2 in front, 2 in back)
4. Carefully pry the Advanced Personality PCB away from the Advanced Backplane PCB.

Note: Be careful not to bend or break the pins when reinstalling any PCB.

Printed Circuit Boards (PCBs)

This section details removing the printed circuit boards from the card cage in the event you need to replace cards individually. This section also provides steps for removing other PCBs from the MCS+.

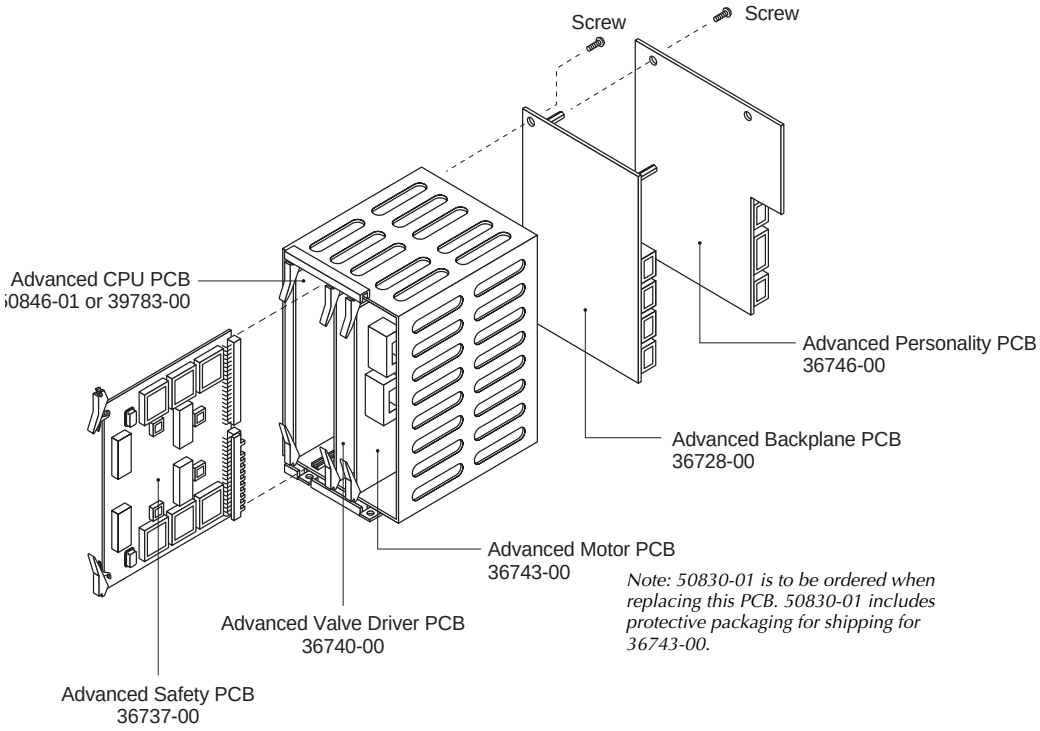


Figure 5-3, Card Cage

Advanced Processor PCB

Note: The CPU PCB is located in the first slot on the left (facing the rear of the machine).

1. Remove the Front and Rear Panels.
2. Remove the ribbon cable from the Advanced Processor PCB.
3. Unclasp the PCB levers and unplug the Advanced Processor PCB from the Advanced Backplane PCB.
4. Slide the Advanced Processor PCB out of the card cage.

Advanced Safety PCB

Note: The Advanced Safety PCB is located in the second slot from the left (facing the rear of the machine).

1. Remove the Rear Panel.
2. Unclasp the PCB levers and unplug the Advanced Safety PCB from the Advanced Backplane PCB.
3. Slide the Advanced Safety PCB out of the card cage.

Advanced Valve Driver PCB

Note: The Advanced Valve Driver PCB is located in the third slot from the left (facing the rear of the machine).

1. Remove the Rear Panel.
2. Unclasp the PCB levers and unplug the Advanced Valve Driver PCB from the Advanced Backplane PCB.
3. Slide the Advanced Valve Driver PCB out of the card cage.

Advanced Motor Driver PCB

Note: The Advanced Motor Driver PCB is located in the fourth slot from the left (facing the rear of the machine).

1. Remove the Rear Panel.
2. Unclasp the PCB levers and unplug the Advanced Motor Driver PCB from the Advanced Backplane PCB.
3. Slide the Advanced Motor Driver PCB out of the card cage.

Advanced Personality PCB

1. Remove the Front and Rear Panels.
2. Remove the cards from the card cage, as instructed earlier in this section.
3. From the front of the machine, disconnect the following from the Advanced Personality PCB:

   P508, P507, P506, P510, P505, P504, P503, P513 Ribbon Cable, P2 to Cuff Air hose, P512 Ribbon Cable, P509 Ribbon Cable, P502 Ribbon Cable, P501, and P511.
4. Disconnect P502 from the Advanced Backplane PCB.
5. Remove the (2) Phillips head screws which secure the Advanced Personality PCB to the card cage.
6. Remove P501 and TS1 ground wires from the Advanced Personality PCB.

Advanced Backplane PCB

1. Remove the Advanced Personality PCB.
2. Remove the (8) Phillips head screws which secure the Advanced Backplane PCB to the card cage.

Top Deck Distribution PCB

Note: **When removing the Top Deck Distribution PCB, first remove the centrifuge assembly to gain better access to the Top Deck Distribution PCB.**

1. Disconnect the following connectors:
   - Pinch Valves
     - P628 (red)
     - P629 (blue)
     - P630 (yellow)
     - P631 (white)
     - P632 (green)
   - Donor Line Air Detectors
     - P606 (DLAD1)
     - P607 (DLAD2)
   - Ribbon Cables
     - P601
     - P602
2. Label and disconnect the pneumatic connections on the valve manifold.
3. Disconnect the following:
   - P608 (SPM)
   - P610 (Donor Lights)
   - P612 (Line Sensor)
   - P623 (Transfer Pump Power)
   - P621 (Anticoagulant Pump Power)
   - P619 (Blood Pump Power)
   - P622 (Transfer Encoder)
   - P620 (Anticoagulant Pump)
   - P618 (Blood Pump Encoder)
   - P617 (Valve Manifold)
   - P614 (Pneumatics Compressor)
   - P605 (Blood Line Air Detector)
   - P604 (Anticoagulant Air Detector)
   - P613 (Protocol ID)
   - P616 (Drip Monitor)
   - P611 (Donor Lights)
   - P609 (DPM)
   - P627 (Purple Valve)
   - P626 (Orange Valve)
4. Remove the (14) Phillips head screws which secure the Top Deck Distribution PCB to the deck.
5. Lower the Top Deck Distribution PCB from the assembly.

Top Deck Disassembly

1. Remove the Front and Rear Panels.
2. Remove the Centrifuge assembly. (Refer to the Centrifuge disassembly instructions.)
3. Disconnect P513 from the Advanced Personality PCB and thread the ribbon cable through the rear panel.
4. Disconnect ribbon cables P601, P602, and P603.
5. Disconnect P511 (weigher) from the Advanced Personality PCB.
6. Disconnect the ground wire at the top deck ground bus that connects to the side panel ground bus.
7. Remove (4) 3/8″ nuts that secure the top deck to the cabinet.
8. Firmly grasp the top deck and pull away from the cabinet.

Air Detector Disassemblies

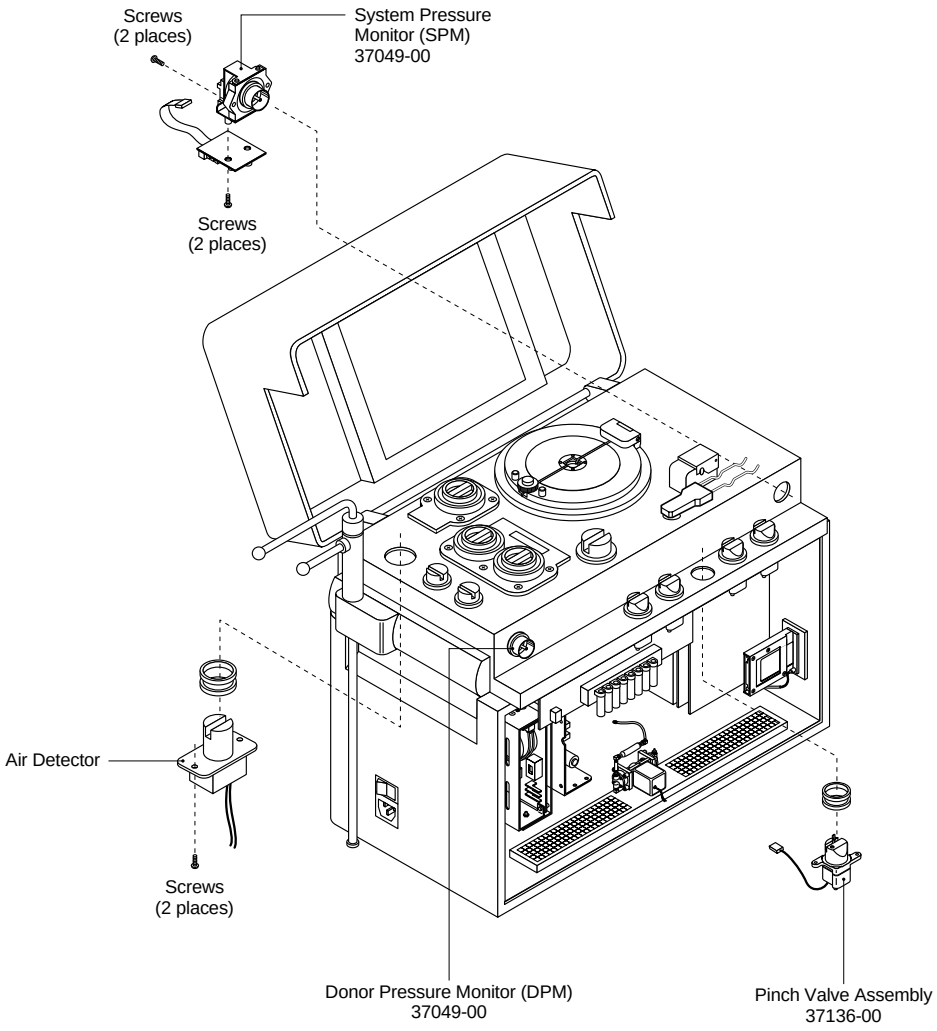


Figure 5-4, Air Detectors and SPM/DPM (note: seven valve device used as an example)

Anticoagulant Air Detector

1. Disconnect P604 from the Top Deck Distribution PCB.
2. Remove the (2) Phillips head screws.

Blood Line Air Detector

1. Disconnect P605 from the Top Deck Distribution PCB.
2. Remove the centrifuge to gain access to the Blood Line Air Detector screws.
3. Remove the (2) Phillips head screws.

Air Detector Reassemblies

Air detectors are keyed to ensure proper location, but the air detectors themselves could accidentally be installed in the wrong location. The Anticoagulant Air Detector at P604 is located towards the back of the MCS+ top deck (near the IV Pole). The Blood Line Air Detector at P604 is located at the front of the MCS+ top deck, to the left of the weigher arm.

When reinstalling the air detectors, be sure the gasket is in place in the panel, and lubricate the inner diameter of the gasket with silicone lubricant to ease the installation of the air detector head.

DPM/SPM Assemblies

Note: The DPM is located on the left of the MCS+, the SPM on the right.

With a thin wall socket, you may be able to remove the DPM and SPM sensors without removing the top deck. Replacing the circuit PCB can be done as an assembly as well.

DPM

1. Remove the top deck, if necessary.
2. Remove the Dual Pump assembly.
3. Remove the Purple Pinch Valve from the Top Deck.
4. Disconnect P609 (to remove DPM) and P608 (to remove SPM) from the Top Deck Distribution PCB.
5. Remove the ground wire from the DPM assembly.
6. Remove the (2) nuts securing the DPM sensor assembly to the top deck.
7. Gently twist and pull the sensor board from the pressure fitting.

SPM

1. Remove P608 from the Top Deck Distribution PCB.
2. Remove the (2) nuts which secure the SPM assembly to the top deck.
3. Remove the ground wire on the SPM assembly.
4. Pull the SPM out of the top deck.

5. With or without first removing the sensor assembly from the top deck, remove the (2) Phillips head screws which secure the sensor board to the sensor assembly.
6. Gently twist and pull the sensor board from the pressure fitting.

Line Sensor

1. Remove the Rear Panel.
2. Disconnect P612 from the Top Deck Distribution PCB.
3. Remove (2) Phillips head screws which secure the Line Sensor to the Top Deck.
4. Lift the Line Sensor up and away from the Top Deck.

Pinch Valves

Follow these steps to remove the red, blue, yellow, white, or green pinch valves. When installing the new valve, be sure to apply vacuum grease to the gasket.

1. Remove the Front Panel.
2. Disconnect the following and remove the associated tubing:
   - P628 (red)
   - P629 (blue)
   - P630 (yellow)
   - P631 (white)
   - P632 (green)
3. Remove the (2) hex nuts which secure the pinch valves to the deck.
4. Slide the pinch valve down to remove it.

Follow these steps to remove the purple and orange pinch valves.

1. Remove the front and rear panels.
2. Disconnect the following and remove the associated tubing:
   - P626 (orange)
   - P627 (purple)
3. Remove the (2) hex nuts which secure the pinch valves to the deck.
4. Slide the pinch valve down to remove it.

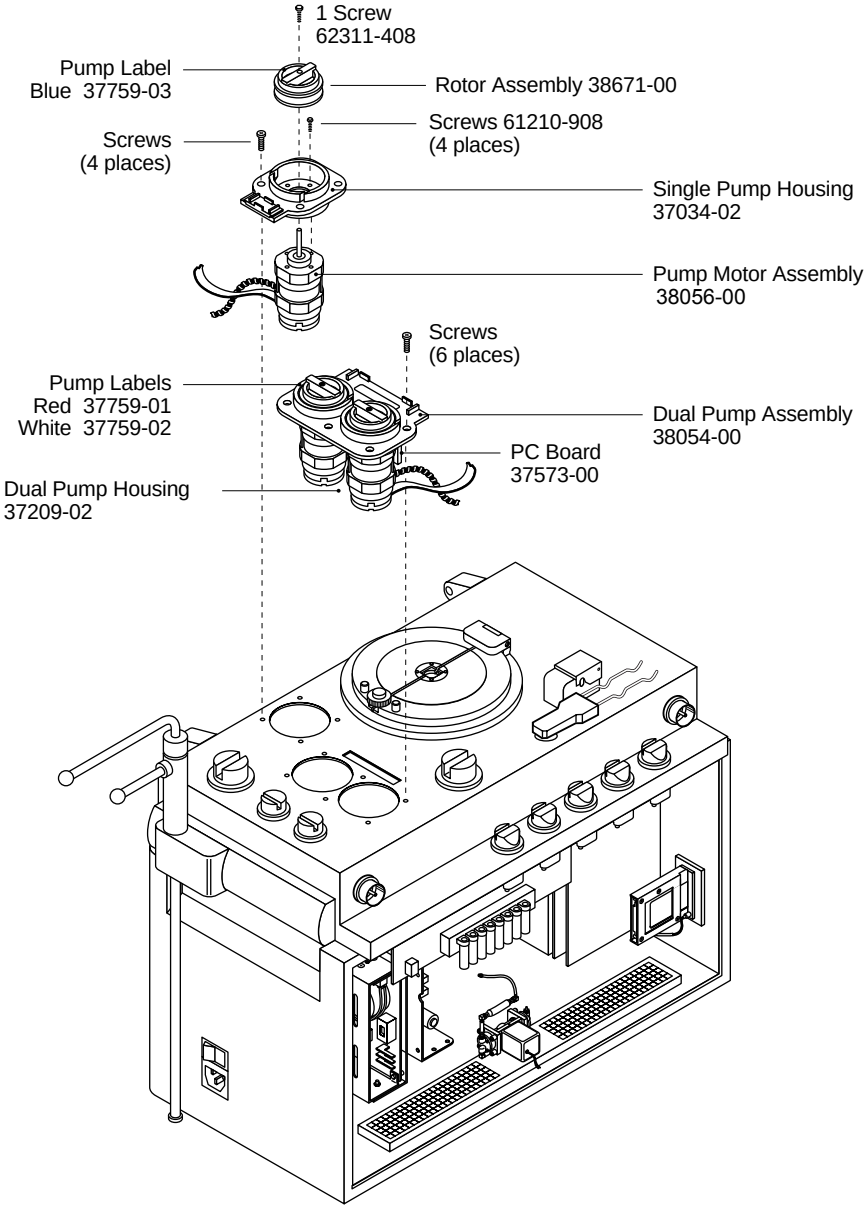


Figure 5-5, Pumps (note: seven valve device used as an example)

Pumps

Dual Pump Assembly

1. Remove (6) Phillips head screws which secure the dual pump assembly to the top deck.
2. Disconnect the following from the Top Deck Distribution PCB:
   - P622 (Transfer Pump Encoder)
   - P618 (Blood Pump Encoder)
   - P619 (Blood Pump Power Cable)
   - P623 (Translator Pump)
   - 1 ground wire
3. Slide dual pump assembly out and away from the top deck.

Disposable ID Reader

1. Remove (4) Phillips head screws which secure the Disposable ID Reader to the dual pump assembly.
2. Disconnect the cable from the Top Deck Distribution PCB.

Single Pump Assembly

1. Remove (4) Phillips head screws which secure the single pump assembly to the top deck.
2. Disconnect the following from the Top Deck Distribution PCB:
   - P621 (Power to A/C Pump Cable)
   - P620 (Encoder) and ground wire
3. Slide the single pump assembly out and away from the top deck.

Pump Rotors

It is not necessary to remove the entire pump assembly to remove or replace the rotors. Simply remove the center hex screw (5/32″) from the top of the pump to expose the rotors.

Pump Motors

Instructions for removing the pump motors are the same for both the single and dual pump assemblies. First remove the pump or pumps from the top deck. Then, remove the (4) hex screws which secure the motor assembly to the pump.

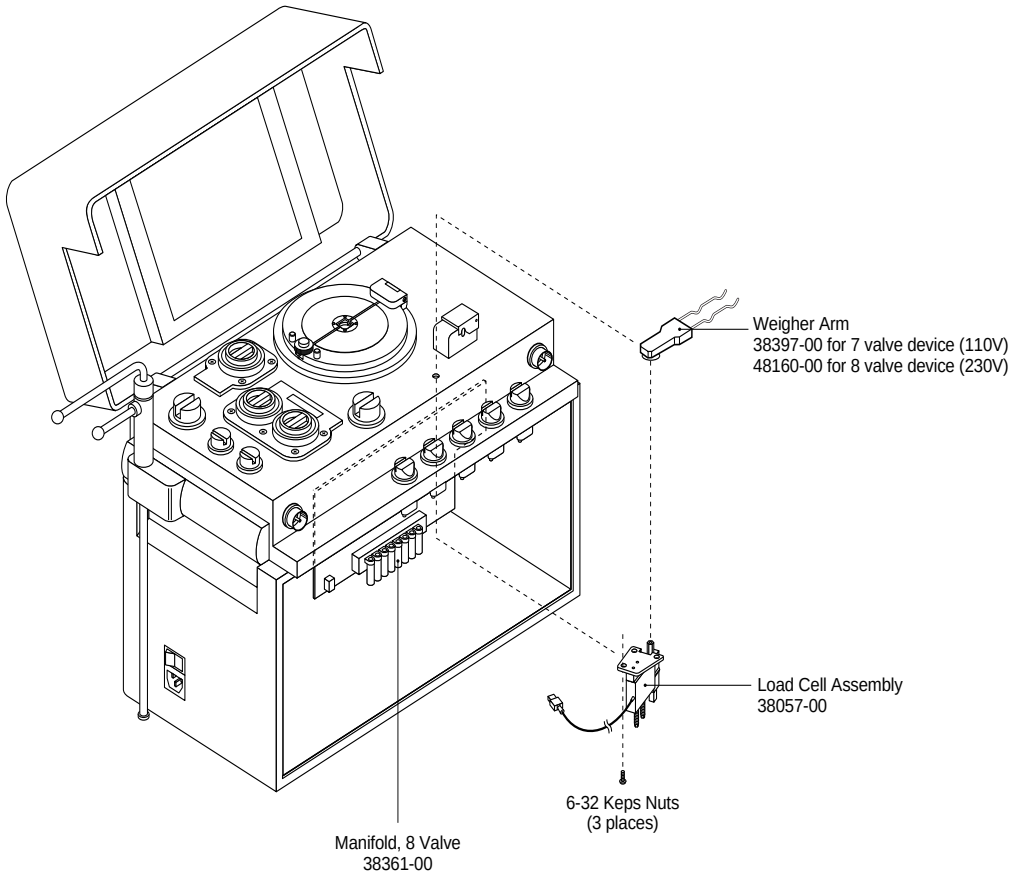


Figure 5-6, Weigher Arm and Load Cell Sensor (note: seven valve device used as an example)

Weigher Arm (old style)

Note: To gain better access to the weigher arm, first remove the centrifuge assembly.

1. Remove the Rear Panel.
2. Using channel locks to grasp the top weigher standoff, unscrew the (1) Phillips head screw from the top of the weigher arm.

Weigher Arm (new style)

1. Loosen the set screw which secures the dowel pin in the arm.
2. Push the dowel pin out of the weigher arm assembly. Remove the weigher arm from the load cell assembly.

Note: Use a drop of purple loctite on the set screw when reattaching the arm to the load cell.

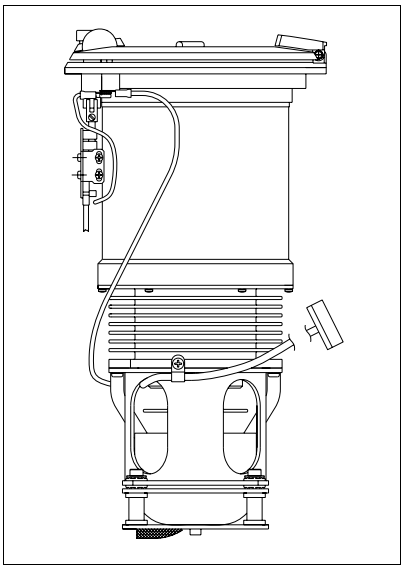
Load Cell Sensor (old and new style)

1. Remove the Rear Panel.
2. From the rear inside of the cabinet, remove the (3) nuts from the weigher plate assembly.
3. Pull the Load Cell Sensor assembly away from the top deck.
4. Remove the (3) nuts which secure the weigher arm to the top deck. Lift the weigher arm up and away from the top deck

Centrifuge (Vacuum)

1. Remove the Front and Rear Panels.
2. Remove the (4) #8 hex centrifuge mounting screws securing the centrifuge base to the centrifuge mounting fluid drain assembly. You may need to disconnect the brass nipple on the output line to the pneumatic pump (at the base of the centrifuge pump from the front) in order to reach one of the hex screws.
3. Disconnect the following:
   - Pneumatic Quick Disconnect. Slightly twist the two halves and pull to separate.
   - P503, P505, P506, and P507 from the Advanced Personality PCB.
   - Ground wire (hex #9) leading to the ground bus.
   - Harness from the centrifuge well.
   - Ground wire from the Photoelectric assembly.
   - Grounding strap from the frame.
   - Remove the optics cable from the Photoelectric assembly.
4. Carefully lift the centrifuge up and away from the top deck of the cabinet.

Centrifuge (Mechanical)



1. Remove the Front and Rear Panels.
2. Remove the (4) #8 hex centrifuge mounting screws securing the centrifuge base to the centrifuge mounting fluid drain assembly.
3. Disconnect the following:
   - P503, P504, and P506 from the Advanced Personality PCB.
   - Ground wire (hex #9) leading to the ground bus.
   - Harness from the centrifuge well.
   - Grounding strap from the frame.
   - Remove the optics cable from the Photoelectric assembly.
4. Carefully lift the centrifuge up and away from the top deck of the cabinet.

Centrifuge Cover

Centrifuge Cover Interlock

Remove the (2) Phillips head screws which secure the cover interlock to the centrifuge.

Cover Switch

1. Remove the centrifuge from the cabinet.
2. Remove the (2) screws which secure the cover switch assembly to the centrifuge well.
3. Pull the cover switch assembly away from the centrifuge well.

Cover Switch Reassembly Notes

Note: The cover switch assembly mounting position is a calibration step.

1. Set switch engagement of cover switch assembly to the bottom of the shaft so that there is 3/8 to 5/8 clockwise turn of the centrifuge knob after both switches have been disengaged.
2. Check the switches with an ohmmeter. Verify that both switches respond to the cover latch, and that the switches are closed when the cover latch is engaged.

Cover Latch (Vacuum Centrifuge)

Note: The knurled knob has a knob disk (cap) that is permanently bonded to the knob. The knob disk must be removed to access a button head screw that retains the knob on the lock shaft. These instructions are provided in case the lock shaft breaks.

1. Remove the knob disk. This is accomplished by placing a thin flat screwdriver in the gap between the knob disk and the knob and tapping on the back of the handle of the screwdriver until the cap detaches from the knob.
2. The knob disk is affixed to the knob with Loctite, and it may be difficult to detach. Do not worry about damaging these components as they are going to be replaced.
3. Remove the centrifuge from the cabinet.
4. Remove the cover switch assembly from the centrifuge.
5. Remove the knob by unscrewing the retaining screw and unscrewing the knob from the centrifuge lock shaft.
6. Twist the centrifuge shaft spacer counterclockwise using vice grips or locking pliers. As the centrifuge shaft spacer is removed, the centrifuge lock shaft will drop out from the bottom of the centrifuge cap assembly. Save the spring for reuse with replacement parts.
7. Place the compression spring on the replacement lock shaft and insert it into the centrifuge cap assembly.
8. Prime and loctite the lock shaft threads at the base only, and then screw the centrifuge shaft spacer (threads up) on the lock shaft until the spacer bottoms out. Be sure that no loctite is touching the centrifuge cap assembly where the shaft and the spacer come into contact with the centrifuge cap assembly.
9. Thread the large knurled centrifuge knob (flat side up) onto the lock shaft.
10. Install the O-ring into the channel of the centrifuge knob cap. Apply a light coating of vacuum grease or O-ring lubricant.
11. Apply a small amount of purple loctite onto the top of the lock shaft and thread the knob cap onto the shaft. Tighten the cap using a small set of needle-nose or snap-ring pliers.
12. Close centrifuge cover halves to check the general operation of the assembly.
13. Apply a small amount of green loctite to the underside edge of the knob disk and set it onto the knob cap. Wipe off any excess loctite.
14. Install the cover switch assembly and calibrate the switch position.
15. Install the centrifuge into the cabinet.

Centrifuge Cover Reassembly Notes (Vacuum Centrifuge)

The hex shoulder screws are designed to be completely tightened and a nylon washer is fitted to provide a moderate amount of rotational resistance for each cover half. In some cases, tightening the shoulder screw completely may result in an immobile cover half, due to an oversized nylon washer. It is extremely important that the shoulder screw is secured to the cover hinge with loctite. Otherwise, the shoulder screw may loosen and cause the cover half to vibrate.

Note: **Also, since the cover halves are hinged, they must be aligned so they simultaneously touch the cover latch when closed.**

1. First mount one cover half completely, using loctite.
2. Lower the cover half and slide it closed against the cover latch.
3. Position the second cover half (with the nylon washer installed) along the cover latch and the cover hinge.
4. Carefully slide the cover halves open (they are now geared) while maintaining the proper cover hinge position, then raise the cover halves.
5. Loctite and install the shoulder screw into the second cover half.

Using the Centrifuge Hinge Bushing Adjustment Kit (38064-00)

1. Remove the two (2) headless shoulder screws at the centrifuge cover hinge area, prime the screws, and set aside.
2. Using shoulder screw P/N 13833-19, loosely fasten the centrifuge cover hinge on the side near the line detector.
3. Fasten opposite side of hinge using bushing press tool P/N 38067-02 and tighten until the tool makes contact with the bronze bushing in the hinge. Tighten the shoulder screw. Turn the bushing press tool until the bushing just makes contact with the surface of base hinge.
4. Check to make sure there is no side-to-side end play between the cover hinge and base hinge.
5. Remove the bushing press tool and install one of the two previously removed headless shoulder screws using purple loctite.
6. Remove the shoulder screw P/N 13833-19 and install the second of the two previously removed headless shoulder screws using purple loctite.

Hydrophobic Filter (Vacuum Centrifuge)

1. Open the centrifuge cover halves.
2. Pry the white O-ring located in the center of the centrifuge base.
3. Using a sharp object, pry the white hydrophobic filter from the centrifuge base. Removing the support screen is very difficult. Persistent prying will result in success.

Note: **The filter will not be reusable once pried from the centrifuge.**

Fluid Sensor

1. Remove the (1) center Phillips head screw from the fluid sensor assembly PCB.
2. Disconnect J504 from P504.
3. Gently twist the fluid detector assembly out of the centrifuge well.

Note: The mechanical centrifuge has two (2) spill detectors.

4. All machines after S/N 01M185 use a long fluid sensor which is attached by an adhesive.

Optics Block

For instructions on disassembling the Optics Block assembly and proper alignment, refer to the Preventive Maintenance Chapter.

Note: The entire Optics Block assembly should be replaced as a set.

L and Filler Gasket Replacement (Vacuum Centrifuge)

Table 5-1 lists the parts needed to replace the L and Filler Gaskets.

Table 5-1: L and Filler Gasket Parts

Part Name	Part Number
L-Gasket Seal	39487-00
Filler Gasket	39501-00
GE RTV 118 Sealant	39697-00
MCS+ Optics Alignment Fixture	ETE-5007
Bonding Fixture	ETD-5225
Vacuum Grease	36276-00
Alcohol Pads	N/A
NAPHTHA	N/A
Q-Tips with Wooden Handles	N/A
Powder-Free Gloves	N/A

Removing existing L and Filler Gaskets

1. Remove the rear panel. Verify the bleed rate of the vacuum system before installing the L and Filler Gaskets and make any necessary repairs. Refer to the Preventive Maintenance section in Chapter 4.
2. Remove the existing L and Filler Gaskets from the Centrifuge chuck.

Cleaning the gaskets and centrifuge

Note: Wear powder free gloves for the following steps.

1. Using NAPHTHA to remove any vacuum grease, clean the groove to the outer edge of the chuck and the top outer ring. Clean the area with Alcohol Pads for a minimum of 5 minutes.

Note: Let the area dry for a minimum of 10 minutes before installing the L-Gasket.

2. Clean the L and Filler Gaskets with an Alcohol Pad and place on a clean surface. Allow the seal to dry.
3. Clean the face of the L-Gasket installation fixture (Part Number ETD-5225) with an Alcohol Pad.

Running the MCS+ Diagnostics and using the Bio-Tek pressure meter

1. Power on the MCS+ and enter into the Diagnostics Mode.
2. Select Centrifuge from the main menu using the MODIFY key to move the cursor. Press the DRAW key to enter the Centrifuge Diagnostics screen.
3. Disconnect the vacuum line at the centrifuge by using the quick disconnect. Install the Bio-Tek pressure meter (or equivalent) in line with the centrifuge vacuum. Set the Bio-Tek meter to the **-13.5 to -15 psi** scale.

Installing the L-Gasket

Note: Read the following steps before proceeding. It is recommended that a dry fit be done prior to the actual installation to become familiar with the procedure.

1. Apply a thin even coat of vacuum grease into the area of the seal mounting fixture that comes in contact with the seal upon installation. Place the L-Gasket on the fixture.

Warning! Do not let the grease come in contact with the seal surface to be glued!

2. Apply a thin even coat of GE RTV 118 all around the L-Gasket. Use the wooded end of the Q-tip to spread the RTV evenly.

Note: Once the glue has been applied, the L-Gasket must be installed within 15 minutes.

3. Carefully insert the fixture with the L-Gasket into the centrifuge chuck and seat it uniformly.

   If the L-Gasket is slightly oversized and does not fit into the chuck evenly, it may be necessary to remove the seal installation fixture and smooth out the gasket by hand, then replace the fixture.

Priming the Vacuum Pump

1. Turn the vacuum pump on by pressing the PRIME key. When the pump reaches a level of **-5.8 psi,** immediately press the PRIME key to turn off the vacuum pump.
2. Power off the MCS+ and let the RTV cure for a minimum of 2 hours with the fixture in place.

Installing the Filler Gasket

1. Press the dump valve and remove the fixture from the chuck. Clean the fixture.
2. Inspect the Bowl Seal to ensure that it is seated evenly all the way around the chuck, and that the adhesive is evenly distributed.

Cleaning and Lubricating the surface and gasket

1. Clean all exposed seal surface with an Alcohol Pad to remove any debris.
2. Lubricate the Filler Gasket (Part Number 39501-00) with a light, even amount of vacuum grease and install the Filler gasket.

Note: **The Filler Gasket must lie flat and spread evenly in the groove.**

3. Lubricate the L-Gasket with a light even amount of vacuum grease.

Performing the Test Procedure

1. Perform the Centrifuge Test Procedure. See the Preventive Maintenance chapter for instructions.
2. Remove the vacuum test harness and the Bio-Tek meter. Reconnect the vacuum lines inside the MCS+ and replace the rear panel. Ensure that the cuff is operational.

Seal Replacement (Vacuum Centrifuge)

Table 5-2 lists the parts needed to replace MCS+ Rotary Seal.

Table 5-2: Seal Replacement Parts

Part Name	Part Number
Seal Replacement Kit	37210-00
Green Loctite Sealant RC680	10421-00
Purple Loctite #222	10422-00
Seal Replacement Tool Kit • Shaft Ext. Tool • Seal Alignment Tool	37211-00 37163-02 37161-02
Primer N	764

Removing and Preparing the Centrifuge

1. Remove the Centrifuge from the MCS+ and place it upside down on a work table.
2. Remove the right angle vacuum fitting (Part Number 36249-00). Save the fitting, tube, and quick disconnect. The right angle fitting is a two piece assembly held together by an O-ring which is placed over the threaded end. Make sure the O-ring is in place.
3. Remove the end cap (Part Number 35285-02) by removing the two Hex head cap screws. If the end cap is stuck in place, tap it lightly to break it free. Remove the gasket from under the end cap. Discard the gasket, end cap, and two Hex head screws.
4. Remove all debris from the seal area.
5. Using Primer N(764) and small cloth or cotton swab, clean the inside of the centrifuge shaft and the small diameter side of the extension shaft to prepare the surfaces for proper bonding. Allow the primer to dry for approximately 5 minutes.
6. Using a cotton swab, apply a thin coating of Green Loctite Sealant RC680 to both the small diameter side of the shaft extension, and to the inside of the centrifuge shaft.

Using the Shaft Extension Tool

1. With a twisting motion, insert the small diameter side of the shaft extension into the centrifuge shaft. Ensure that the shaft extension is all the way down the centrifuge shaft.
2. Clean off any excess loctite. Pick up the centrifuge and reach in through the cover to spin the centrifuge. Watch the extension shaft to ensure that the movement is symmetrical. If the rotation of the extension shaft is not symmetrical, the shaft must be repositioned or adjusted to that the rotation is symmetrical before the loctite has time to set.
3. Place the shaft extension tool (Part Number 37163-02) over the extension shaft. The hollowed side of the shaft extension tool goes toward the centrifuge and should fit snugly over the motor end bell.

Note: **Rotate 1/4 turn to make sure it is seated onto the motor end bell. Ensure that the shaft extension is flush with the surface of the shaft extension tool and seated by pressing down on the shaft extension.**

4. Leave the shaft extension tool in place for a minimum of **30 minutes** to let the loctite cure. After 30 minutes, remove the shaft extension tool.

Installing the new End Cap

1. Take the new end cap from the seal replacement kit and remove the right angle fitting adapter and set it aside.
2. Insert the seal alignment tool (Part Number 37161-02) through the back of the end cap and through the seal. Since the seal is tight, push the alignment tool back and forth to break through the seal.
3. Apply vacuum grease to the outside diameter of the exposed portion of the shaft extension. If grease gets into the open end of the shaft extension, clean it thoroughly with a cloth or cotton swab and proceed to the next step.
4. Install the cap end onto the motor end bell of the centrifuge ensuring that the tip of the seal alignment tool enters into the extension shaft. Line up the two holes in the end cap with the threaded holes in the motor end bell. Hold the knurled end of the seal alignment tool and push down slightly to ensure that it is in place. Push the end cap assembly onto the motor end bell until it seats.
5. Prime the #40-40 x 3/4 self-sealing Phillips head screws with purple loctite #222. Secure the end cap in place using the two Phillips head screws. Alternate the tightening of the two screws as the cap may seat further as the screws are tightened.
6. Remove the seal alignment tool. Screw the right angle fitting adapter back into the end cap assembly until fully seated. Screw the right angle vacuum fitting onto the fitting adapter with the tube exiting through the base of the centrifuge aligning with the optics block slot. Tightly secure the screws.
7. Reinstall the centrifuge into the MCS+. See the Centrifuge reassembly notes in this chapter for instructions.

Checking for Vacuum Leakage

1. Install a bowl half filled with water into the centrifuge.
2. Power on the MCS+ and enter into the Diagnostics mode.
3. Select Centrifuge from the main menu using the MODIFY key to move the cursor. Press the DRAW key to enter the centrifuge diagnostics screen.
4. Disconnect the vacuum line at the centrifuge by using the quick disconnect. Install an in-line vacuum measuring device capable of measuring **0 to 15 psi or -20 to -30 inHg.**

5. Increase the Centrifuge speed from 2000 to 4800 RPM using the arrow keys. Press the DRAW key to start spinning the centrifuge.
6. After the centrifuge reaches the speed of 4800 RPM, press the PRIME key to turn off the vacuum pump. Verify that the vacuum reading on the in-line measuring device bleeds off no faster than 1 psi/second, or 2 InHg/30 seconds.
7. Press the PRIME key and allow the centrifuge to run for 30 minutes, then repeat the previous step.

Note: **If the vacuum system leaks greater than 1 psi/30 seconds or 2 InHg/30 seconds, check the vacuum system and repair as necessary. See the Troubleshooting chapter for instructions on repairing the vacuum system.**

8. If the vacuum system passes the leak test, run the MCS+ through a functional check by performing the centrifuge diagnostic tests.

Centrifuge Reassembly Notes (Vacuum and Mechanical)

The centrifuge must be centered in the Top Deck cavity to prevent contact of the centrifuge with the cabinet during operation. If true centering cannot be achieved, ensure that the centrifuge is at least 1/16" from the cabinet, measured at 4 points separated by 90 degrees.

The centrifuge location is adjusted by leaving the (4) centrifuge mounting screws loose.

Using the centrifuge alignment fixture (#ETC-5045), check that the centrifuge is centered in the deck opening as follows:

1. Place the narrow rim of the fixture under the centrifuge rim and against the centrifuge in three or four places.
2. Move the centrifuge until the distance is equal.
3. Tighten the (4) mounting screws.

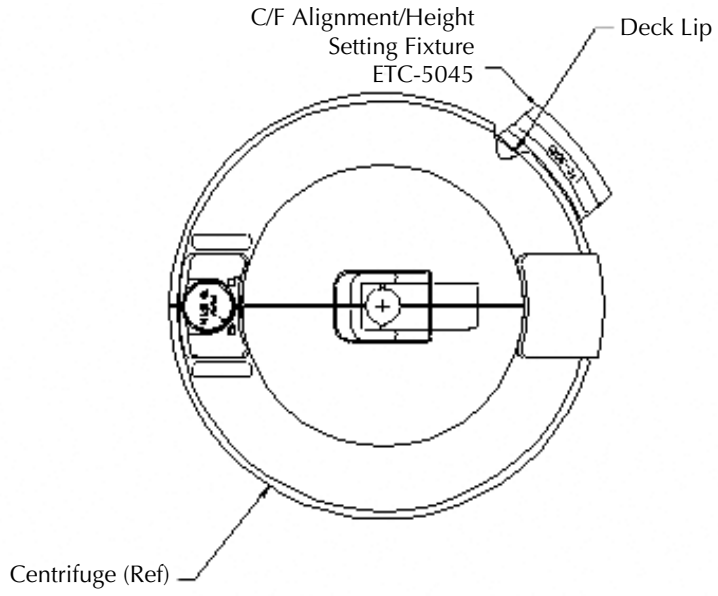


Figure 5-7, Centrifuge

Top Cover

1. Remove the Front and Rear Panels.
2. Disconnect P513 from the Advanced Personality PCB.
3. Disconnect the display ground wire from the ground bus on the cabinet side.
4. Remove the (2) lower Phillips head screws securing the membrane panel ribbon cable to the upper deck.
5. Remove the (2) #10 hex shoulder screws securing the top cover assembly to the top deck while supporting the top cover assembly.

Membrane Panel

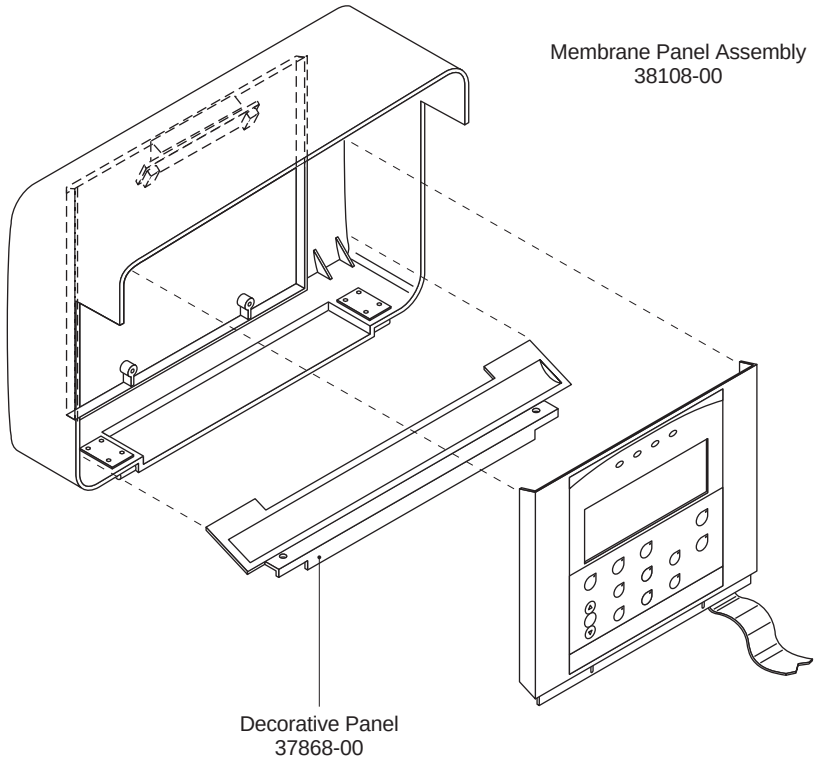


Figure 5-8, Membrane Panel

1. Remove the (2) Phillips head screws securing the fiberglass decorative panel to the top cover assembly.
2. Remove the (2) Phillips head screws securing the membrane panel to the top cover assembly.
3. Pull the base of the membrane panel down and away from the top cover assembly simultaneously to disengage the top panel catches from the catch plate.
4. Carefully pull the top of the membrane panel down to expose the inner wiring of the membrane panel.

Display Controller PCB

1. Remove the membrane panel assembly from the top cover assembly.
2. Remove the (4) Phillips head screws to remove the Display Controller PCB from the Membrane Panel.
3. Disconnect J2 from the Display Controller PCB.
4. Disconnect the J1 ribbon cable.
5. Disconnect the gray ribbon from the Membrane Panel PCB.
6. Disconnect J4 from the Display Controller PCB.
7. Disconnect the ground wire from the ground lug.

Donor Lights (on Membrane Panel)

1. Remove the Membrane Panel.
2. Disconnect J1 and J2 from the Donor Light PCB.
3. Remove the (2) nuts which secure the Donor Light PCB.

Membrane Switch Key

Note: **Prior to removing the Membrane Switch Key, first remove the Donor Light PCB and Display Controller PCB.**

1. Remove the (6) nuts which secure the Membrane Switch Key to the top cover.
2. Using considerable force, peel the membrane panel edges away from the top cover panel fascia and push the membrane panel through the top cover panel fascia.

Note: **The membrane panel cannot be reused.**

Donor Lights

1. Remove the Top Cover and Rear Panel.
2. Remove the Membrane Panel.
3. Disconnect J2 from the Donor Light PCB.
4. Remove the (2) Phillips head screws.

Cabinet

Remove the Front and Rear Panels to gain access to the components inside the MCS+ cabinet.

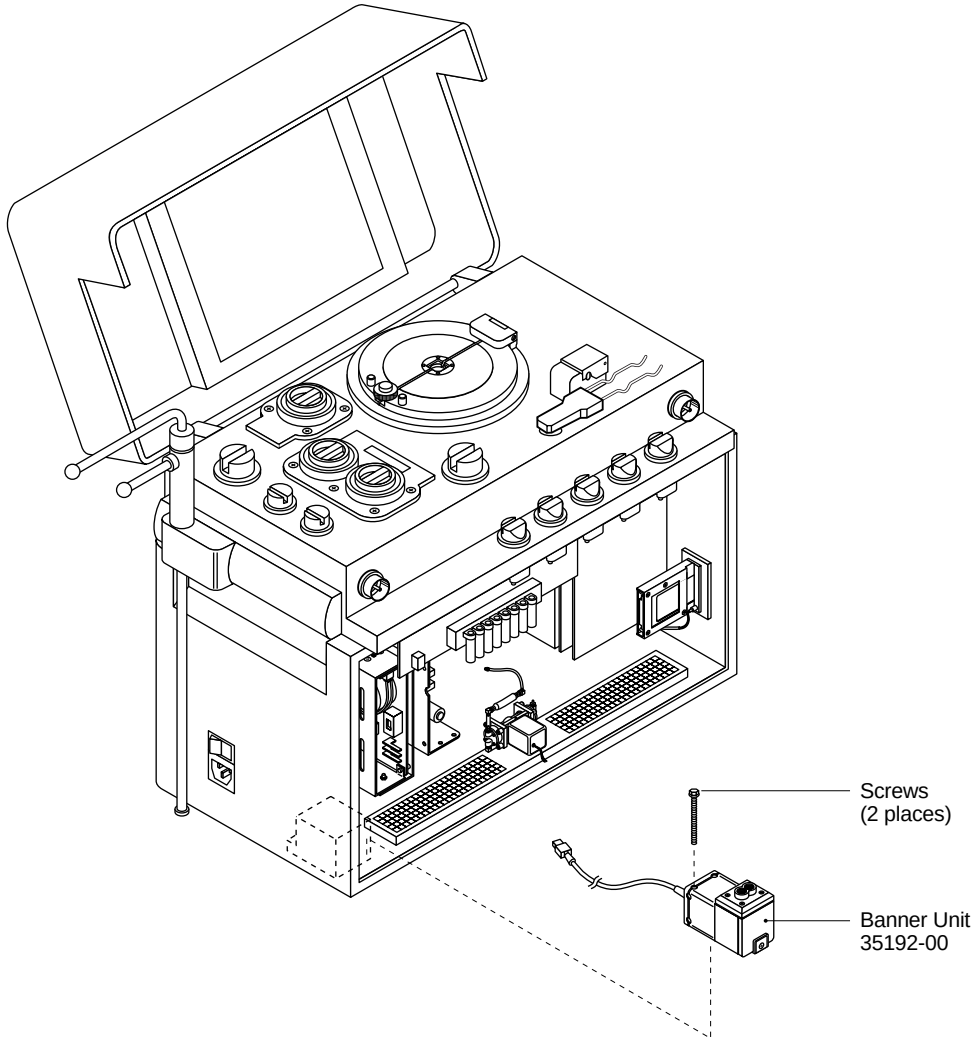


Figure 5-9, Photoelectric Assembly (note: seven valve device used as an example)

Photoelectric Assembly

1. Remove the Front Panel.
2. Remove the (2) fiber optic cables from the Photoelectric assembly.
3. Remove the (2) Phillips head screws which secure the Photoelectric assembly to the MCS+ frame.

Cuff Compressor

1. Remove the Front Panel.
2. Remove the Cuff Compressor from the clip.
3. Disconnect P510 from the Advanced Personality PCB.
4. Remove the Pneumatic tubing at the “T” fitting.
5. Life the compressor away from the MCS+.

Donor Light Assembly (Handles)

1. Remove the Rear Panel.
2. Remove the (2) Phillips head screws which secure the donor light PCB to the cabinet.
3. Disconnect J1.

Drain Tube

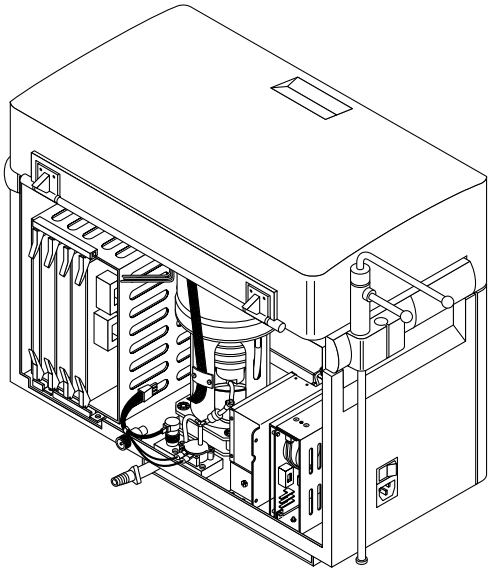


Figure 5-10, Drain Tube (note: seven valve device used as an example)

1. Tilt the cabinet and remove the (4) Phillips head screws securing the spill bag plate to the base of the cabinet.
2. Carefully cut the tubing from its mount.
3. Replace with new drain tube assembly.

Drip Monitor

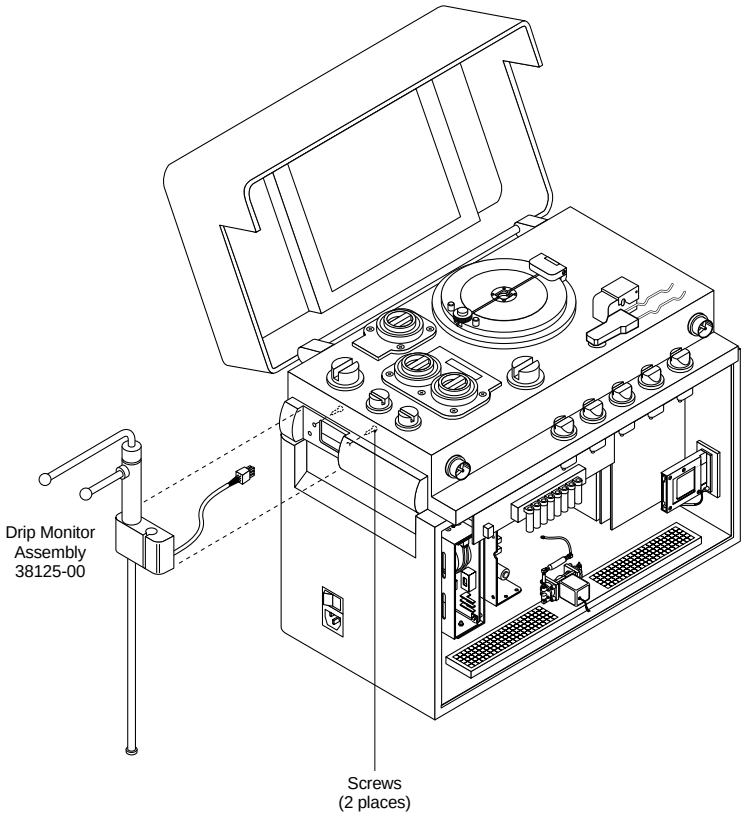


Figure 5-11, IV Pole Assembly installed into Drip Monitor Assembly (note: seven valve device used as an example)

To gain access to the Drip Monitor assembly, it is recommended that you first remove the Anticoagulant Air Detector.

Note: It is also recommended that you use a Chapman Tool Set to remove the IV Pole and Drip Monitor assembly.

1. Remove the (2) set screws which secure the IV Pole assembly and PCB to the MCS+.
2. Disconnect P2 (Drip Monitor Cable) from the Drip Monitor PCB.

Note: To gain access to the IV Pole and Drip Monitor assembly, it is recommended that you first remove the Anticoagulant Air Detector.

Note: It is also recommended that you use a Chapman Tool Set to remove the IV Pole and Drip Monitor assembly.

1. Remove the Rear Panel.
2. Disconnect the P-style connector leading to the back of the IV Pole and Drip Monitor assembly.
3. Remove the (2) Phillips head screws securing the IV pole holder assembly to the cabinet.

IV Pole

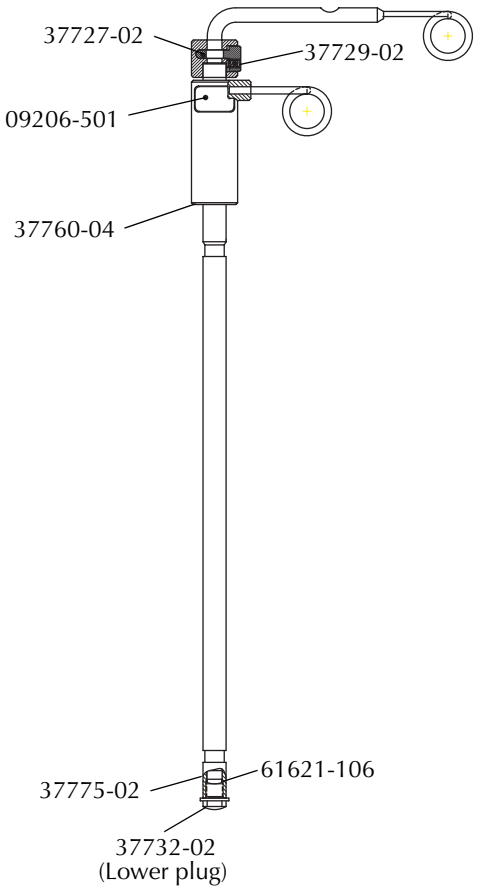


Figure 5-12, IV Pole Assembly

1. Remove the lower plug on the IV Pole assembly.
2. Push and hold the button that allows the IV pole height adjustment at the Drip Monitor assembly.
3. Raise the IV pole assembly out of the Drip Monitor assembly. Take care to gently release the button so as not to loosen the compression spring inside.
4. Place a drop of blue or purple Loctite on the lower plug's threads when reassembling.

Smart Card Reader

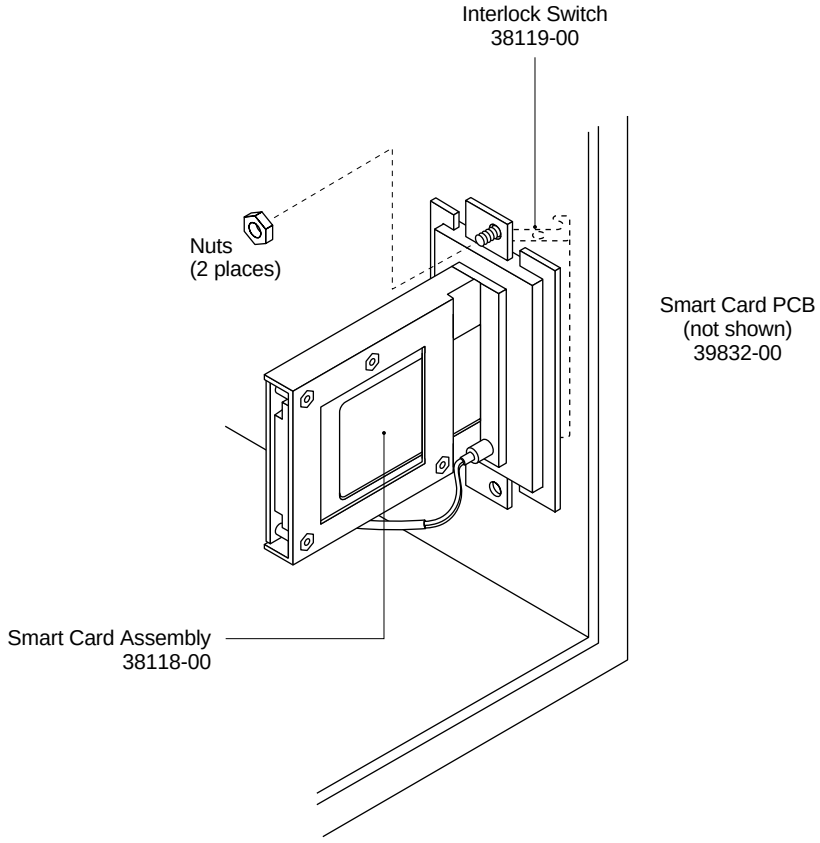


Figure 5-13, Smart Card Reader

1. If there is a Smart Card in the Smart Card reader (located on the right side of the machine as you face the front), remove the card before proceeding with this disassembly.
2. Remove the (2) nuts on the top and bottom using an 11/32″ nut driver.
3. Remove the ribbon cable from the J105 connection on the Advanced Processor PCB.
4. Remove the Smart Card reader from the cabinet.

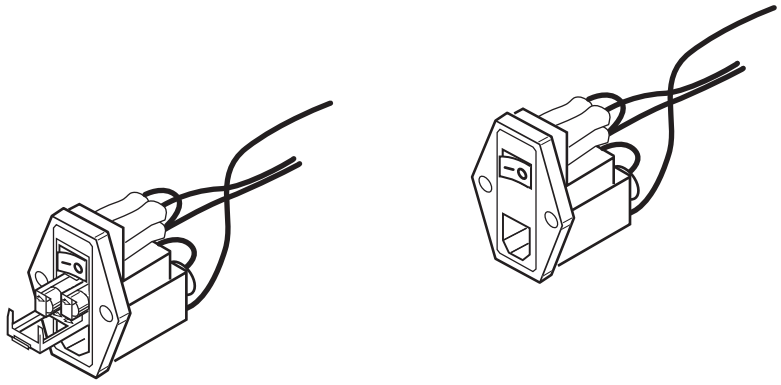


Figure 5-14, Power Entry Module

Power Entry Module

1. Remove the Front and Rear Panels.
2. Remove the Line Filter assembly.
3. Remove the (2) nuts which secure the panel to the side of the MCS+.
4. Remove (2) 1/4″ nuts on either side of the power entry module.
5. Disconnect left top (blue) and bottom (brown) AC power lines from the power entry module and disconnect the ground lug from the ground bus on the cabinet.

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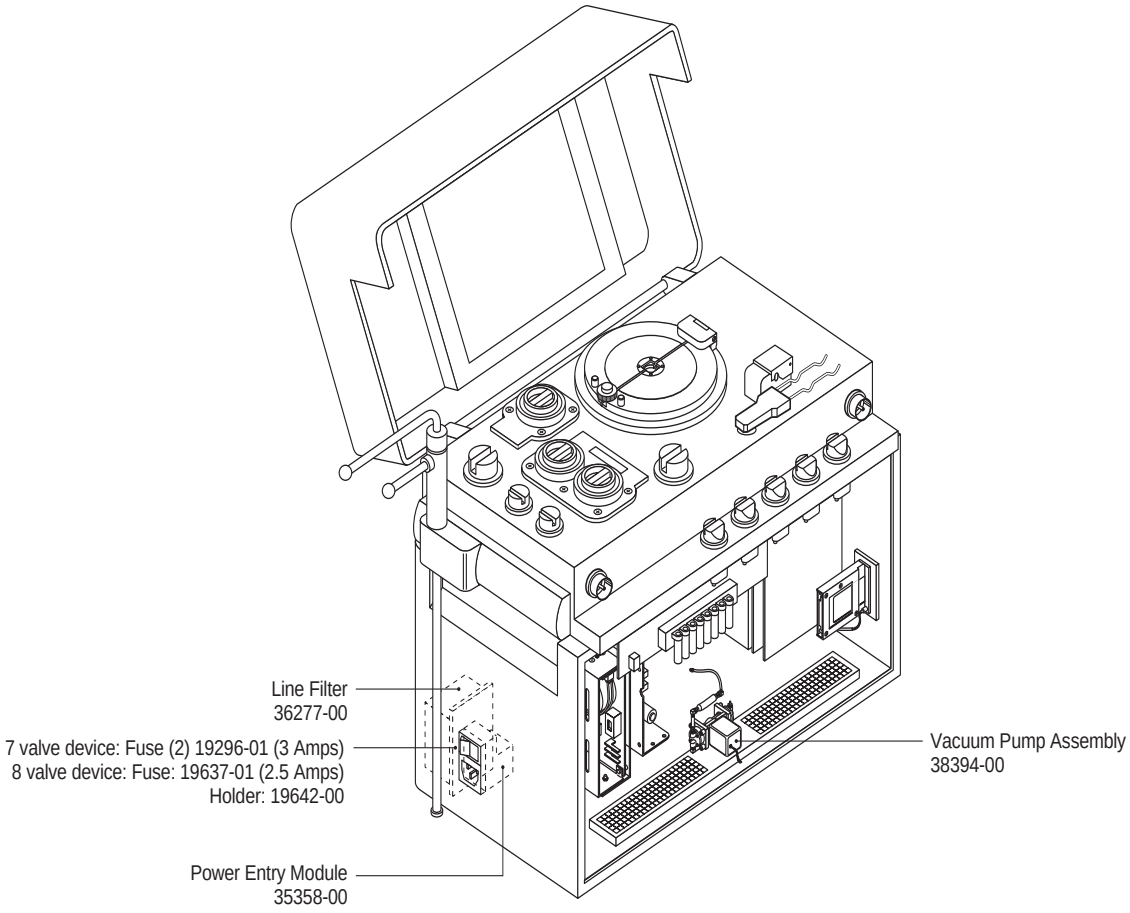


Figure 5-15, Fuse and Line Filter (note: seven valve device used as an example)

Fuse

1. Pry above the power switch on the power entry module to open the fuse cover.
2. Pry out each fuse holder.

Note: When replacing fuse holders, be sure the arrows on the fuse holder and the power input module face the same direction.

Line Filter

1. Remove the Rear Panel.
2. Remove the Phillips head screws which secure the Line Filter to the panel.

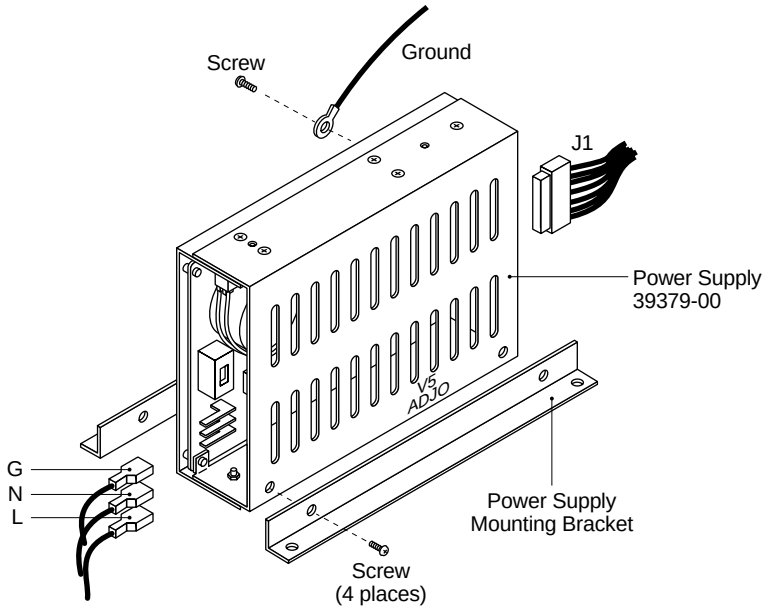


Figure 5-16, Power Supply I (Todd)

Power Supply

Power Supply I

1. Remove the Front and Rear Panels.
2. Disconnect the three leads (brown, green, and blue) from the power entry module.
3. Remove the ground wire from grounding terminal on inside of the cabinet.
4. Remove the connector J1 from the supply.
5. Remove the (4) Phillips head screws which secure the power supply unit to the cabinet.

Power Supply II

1. Remove the Front and Rear Panels.
2. Disconnect the three leads (brown, green, and blue) from the power entry module.
3. Remove the connector j501 from the backplane pcb.
4. Remove the (4) Phillips head screws which secure the power supply unit to the mounting bracket. (One of the four screws is a through screw and is longer than the rest.)
5. Pull the power supply cage out the rear cabinet cavity by lifting the rear edge and pulling the supply up and away from the mounting bracket.

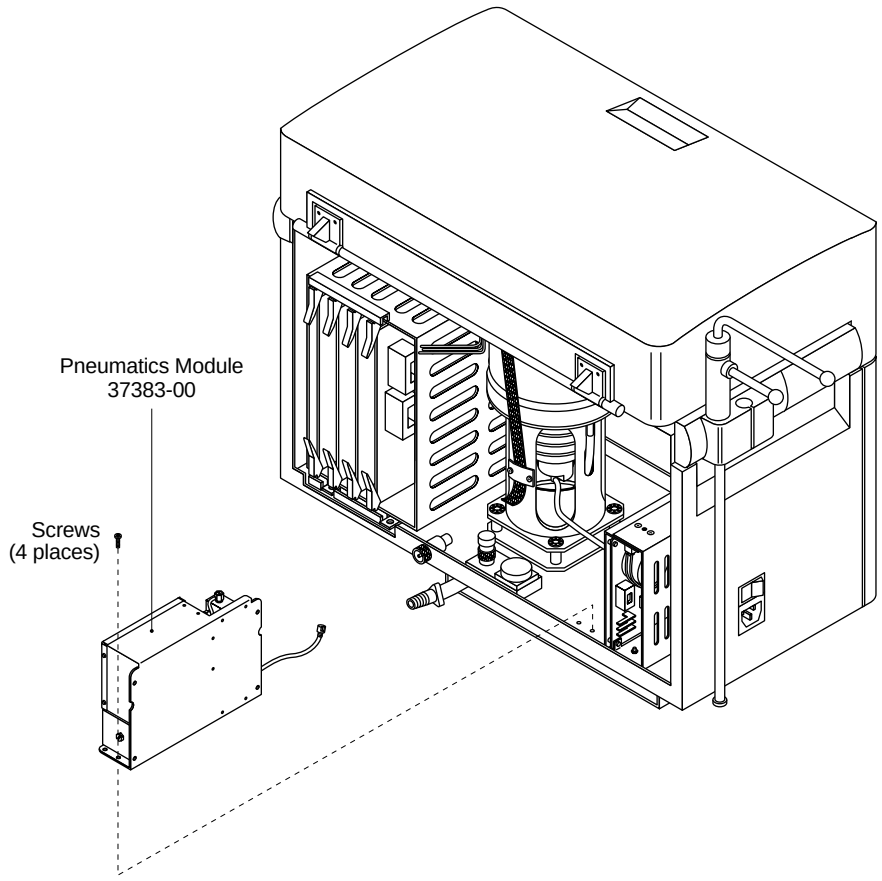


Figure 5-17, Pneumatics Module (note: seven valve device used as an example)

Pneumatic Manifold

1. Remove the Front and Rear Panels.
2. Disconnect P614 from the Top Deck Distribution PCB.
3. Disconnect the pneumatic quick disconnect from the Top Deck Distribution PCB.
4. Remove the (4) large Phillips head screws which secure the pneumatic manifold to the cabinet.
5. Remove the pneumatic manifold.

Control PCB

Remove the (4) Phillips head screws which secure the Control PCB to the Pneumatics Manifold.

Electronic Dump Valve (Vacuum Centrifuge)

1. Remove the Rear Panel.
2. Remove the (2) Phillips head screws which secure the dump valve to the Pneumatic Manifold.
3. Disconnect the 6 pin connector.

Vacuum Pump (Vacuum Centrifuge)

1. Remove the Front Panel.
2. Disconnect P508 from the Advanced Personality PCB.
3. Remove the (2) Phillips head screws which secure the vacuum pump mounting bracket to the vacuum pump mounting plate.
4. Partially remove the vacuum pump from the cabinet, and simultaneously disconnect the input and output pneumatic lines from the pump at the most convenient locations.

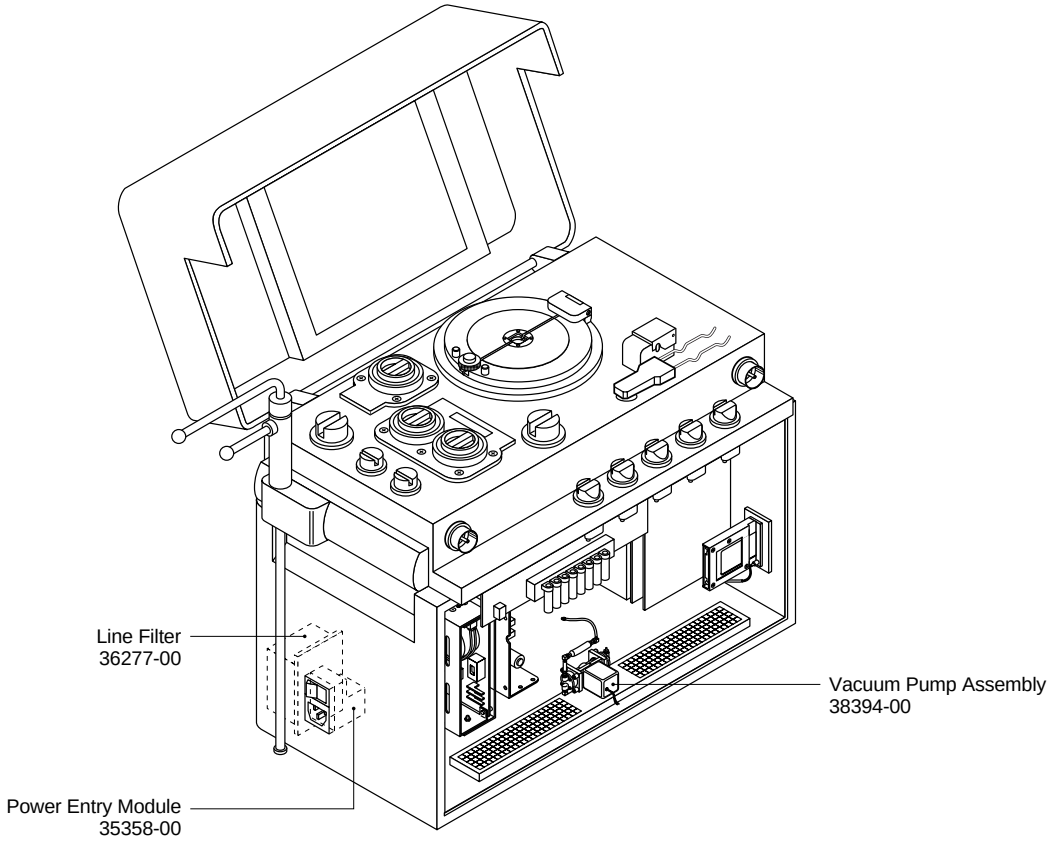


Figure 5-18, Vacuum Pump Location (note: seven valve device used as an example)

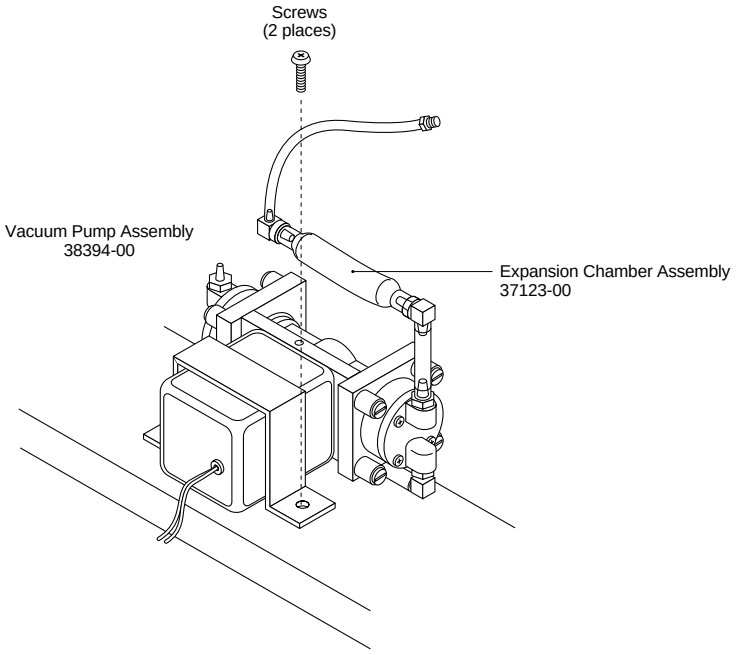


Figure 5-19, Vacuum Pump Assembly

Chapter 6
Troubleshooting

Process Messages

During normal operation, the MCS+ provides information on the progress of a protocol. Process messages are displayed as a normal part of system operation. Donor pressure is continually displayed, as is the current operating mode (Prime, Draw, Return or Surge).

Interlock Messages

As a part of normal operation, the MCS+ prompts the operator to test the components' system interlocks, such as the Centrifuge Cover, the Protocol Card door, the Donor Pressure Monitor, and the System Pressure Monitor. Through the interlock messages, the system computer monitors the integrity of both the machine and the disposable. Such messages do not indicate an error; they are a part of normal operation.

Error Messages

Error messages may be initiated by either the main computer or the safety system which is monitoring the MCS+ at all times during operation. Generally, error messages initiated by the main computer are indications of situations that can easily be corrected.

If an error condition occurs, the operator should record the error code number for later reference. The operator does not have to record the actual error message. Pressing NO mutes the alarm for a period of up to 30 seconds, and pressing HELP displays a Help screen with further troubleshooting hints.

If a safety system message is displayed, the procedure may need to be terminated.

Monitoring of the MCS+ begins the moment the system is powered on. The first action of the MCS+ is to test its own components and ensure that the correct disposable set has been installed properly.

Error History

The Error History menu shows the last ten errors stored in the error history buffer. The errors are listed in reverse order, with the most recent error located at Error 1. Selecting an error provides more detailed information about the error condition as well as the state of the two safety channels on the safety card and the error stack at the time of the error.

ERROR HISTORY

Error 1.	XXX	Error 6.	XXX
Error 2.	XXX	Error 7.	XXX
Error 3.	XX	Error 8.	XXX
Error 4.	XXX	Error 9.	XXX
Error 5.	XXX	Error 10.	XXX

Press STOP to return to the previous screen.
Press MODIFY to change selection, DRAW to execute.

- Press MODIFY to change selection of error.
- Press DRAW to view detailed machine state information.
- Press STOP to exit Error History and return to the Machine Parameters menu.

Error Information

Detailed error information can be displayed to help diagnose the potential problem.

ERROR 1

Error Number:	XXX	Cycle Number:	X
Protocol:	SDP	Date:	1/17/94
Volume Processed:	XXX	Time:	14:04
Mode:	DRAW		
State:	X		

Press STOP to return to the main ERROR screen.
Press DRAW to show safety board status at error time.

- Press DRAW to display the status of the two safety board registers at the time of the error.
- Press STOP to exit Error # and to return to the Error History menu.

Error Safety Board State

Detailed safety system register information can be displayed to help diagnose the potential problem.

ERROR 1							
Channel 1				Channel 2			
1.	ff	6.	ff	1.	ff	6.	ff
2.	ff	7.	ff	2.	ff	7.	ff
3.	ff	8.	ff	3.	ff	8.	ff
4.	ff	9.	ff	4.	ff	9.	ff
5.	ff	10.	ff	5.	ff	10.	ff
Press STOP to return to the previous screen. Press DRAW to view the stack at the time of the error.							

- Press DRAW to view the stack.
- Press STOP to exit the error and return to the Error History menu.

Error Stack Dump

Error stack information can be displayed to help diagnose the potential problem.

ERROR #1
CS: 4000 IP: 023A SS: 0200 SP: 6040
Press STOP to return to the main ERROR screen.

Press STOP to exit Error # and to return to the Error History menu.

Performance Related Problems

Perform the following steps to determine if the error or problem is related to performance:

1. Confirm the specific complaint. For example, low yield, WBC contamination, RBC contamination, or poor product volumes.
   a. Obtain procedural information from the customer as to precount, draw rate, hematocrit, volume processed, flow performance, ACD used, disposable list and lot number, HaemoCalculator predicted results, anticipated results, and final lab results.
   b. Determine how many completed procedures ended in poor results.
   c. Check to see if the plasma was Lipemic.
   d. Calculate the machine efficiency from the supplied data using the following formula and confirm the HaemoCalculator was used properly.

      (Eff. = (Plt Yield * 100,000) / (Vol Proc - ACD) * Precount)

   e. Check all modifiable parameters and ensure that the values selected are defaults or not adjusted to a range that would adversely affect the desired outcome of the protocol. Consult the program settings described in the Operator's Manual for this information.
   f. Ensure that all rotors are seated properly onto the drive pin.
2. If the machine is not operating to optimal levels, perform the following tests:
   a. Test the bowl optics signal.
   b. Test the line sensor signal.
   c. Test the optics aiming volume.
   d. Perform the bowl vibration test.
3. After correcting the problem, complete a diagnostic and functional test of the MCS+ according to the procedures outlined in Chapter 4, Preventive Maintenance, before releasing it to the customer.

Safety System Fault Detection

If the safety system detects a problem, a beeper will sound. Record the error code before powering off the machine. Based on the message displayed, determine if the procedure should be continued. If the procedure must be aborted and sterility of the disposable has not been compromised, gravity flow will have to be used.

Warning! **It is the responsibility of the operator to monitor air management during this procedure. Do not use a pressure cuff or any other mechanical device when reinfusing during a manual gravity reinfusion procedure. Pressure reinfusion can result in the fatal infusion of air into the donor/patient.**

Recovery Procedure

The MCS+ recovery procedure provides the ability to restore the MCS+ from a shutdown state. In the event the MCS+ either shuts down by itself or the unit is switched off during a procedure, recovery data is available for restarting the MCS+ and either continuing with a procedure or restarting the MCS+ for a new procedure.

During the operation of a procedure, system data (volume processed, ACD used, product volume collected, and system offsets for the weigher, cuff, SPM, and DPM) are saved every five seconds and stored to NVRAM. The system data is stored in two copies. The first copy is the most recent system sample. The second copy is one sample period behind the first copy. Both copies of recovery data have their CRC16 stored along with the data each time the system data is sampled.

The recovery data is stored twice in the event the system should shut down or be powered off during the update of recovery data in NVRAM. When the MCS+ is powered back up after a system is shut down and before a procedure is completed, recovery data copies #1 and #2 are checked to make sure that their CRC16 matches the data stored. Recovery data copy #1 is tested first. If its CRC16 does not match its data then copy #1 is considered to be bad. Copy #2's recovery data is then checked (using it as a backup) to make sure that its CRC16 matches the data stored in NVRAM. In the event that recovery data copy #2 is also bad, a message is displayed to the operator that NO RECOVERY DATA AVAILABLE. The operator has forced to start the procedure from the beginning. This forces all system variables to reset.

An error code is displayed whenever NVRAM is replaced, or the system has a memory failure.

Under normal conditions, recovery copy #1's data will match its own CRC16. If copy #1 should be bad then copy #2 is used if its recovery data matches its own CRC16 in NVRAM. When a good copy of data is found (copy #1 or copy #2), a message is displayed to the operator to either press the YES button to restore the previous procedure or the NO button to restart and reinitialize the MCS+ for a new procedure. If the operator selects YES to restore the previous procedure, a second recovery confirmation screen is displayed alerting the operator that a procedure recovery is about to begin. A second press of the YES key is required to begin procedure recovery; otherwise pressing the NO key will abort procedure recovery and start a new procedure.

The MCS+ recovery procedure screen is displayed on power-up whenever the procedure status flag does not get set to procedure complete. In order for the procedure status flag to get set to procedure complete, a procedure must be completed directly to the unload screen. If the operator should elect to restore a previous procedure the system will skip the power-up systems VALVE TEST, disposable installation step, and PRIME state. This is needed to prevent contamination from blood in the disposable that is forced though the disposable from built up system pressure. Also, the weigher will not be tared on the first pass through draw since its offset value is already known from the saved recovery data. Once procedure recovery has been selected the following data is restored:

- All Calibration values (Offsets)
- Cycle #
- Total volume processed
- Plasma volume previous cycle
- Total plasma collected
- Total platelets collected
- Total anticoagulant used
- Protocol used
- Bowl volume
- All HaemoCalculator values
- All Modifiable parameters

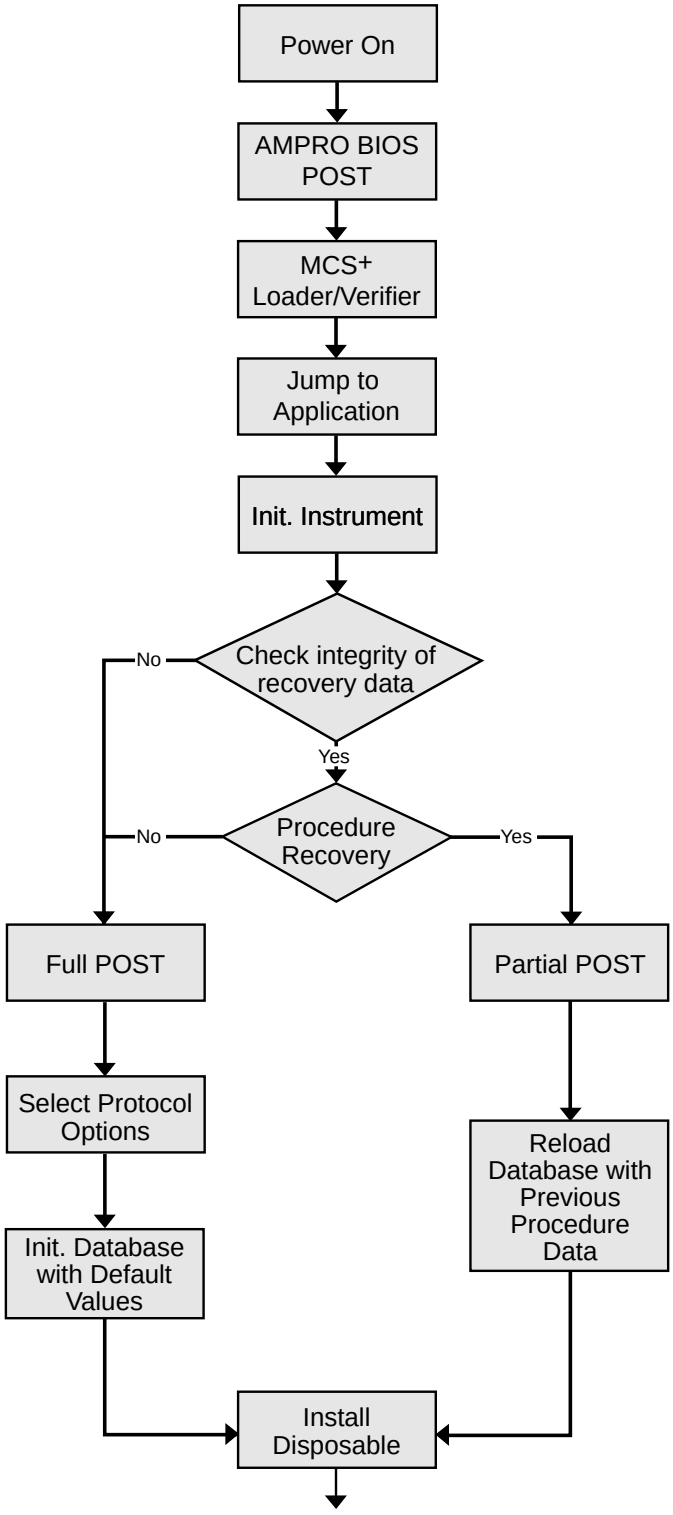
PROCEDURE RECOVERY	
288	THE POWER WAS OFF FOR A SHORT TIME
Press YES for PROCEDURE RECOVERY. Press NO for NEW PROCEDURE. Press HELP for More Information.	

Recovery Sequence

The recovery process is entered under one of two conditions:

1. Power to the MCS+ was lost during processing, or
2. An unrecoverable error was detected during processing. (See Errors section for a description of unrecoverable errors).

If recovery is initiated from an unrecoverable error, it is assumed that the system must be completely reinitialized. It is also assumed that the disposable is loaded and primed. The recovery process is the same under both circumstances and will proceed as in the following chart.


Power On
AMPRO BIOS POST
MCS+ Loader/Verifier
Jump to Application
Init. Instrument
Check integrity of recovery data
No
Yes
Procedure Recovery
No
Yes
Full POST
Partial POST
Select Protocol Options
Reload Database with Previous Procedure Data
Init. Database with Default Values
Install Disposable

Cycle Program

If the MCS+ is powered on with the Diagnostic card installed and with the system bypass assemblies in place, the MCS+ begins an automatic cycling program providing the Utilities menu is not intentionally invoked. This program runs the Diagnostic POST tests, autoloads the pumps, primes the AC line, and then runs a short Draw/Return cycle. When the Return cycle is complete, the MCS+ is rebooted, and the whole cycle repeats itself.

The total number of completed cycles is displayed on the screen while in Draw or Return. This number will continue to accumulate until the machine has been powered off for more than 1 hour, or until the Utilities menu is intentionally invoked.

The cycling program requires that all safety system monitored devices are satisfied. This means that the DPM, SPM, Disposable ID sensor, Centrifuge Bowl Vacuum, and all four Air Detectors must have disposable segments installed. The pumps should also have tubing segments (attached to cartridges) installed. Although this is not mandatory to run the cycling program, frequent pump position errors may occur because the pumps may continue to turn after power has been removed due to inertia.

MCS+ Error Messages

Table 6-1 shows the error messages, in order by error code number. Refer to this section for troubleshooting when errors occur.

Table 6-1: Error Messages

Error Code	Text Message	Description	Suggested Technical Resolution
0	**SYSTEM PROBLEM** THE COMPUTER HAS ENCOUNTERED AN ERROR	A CPU error caused the MCS+ to reset.	1. Replace the Adv. Processor PCB. 2. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 3. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
5	**AIR DETECTED BY** THE BLAD	The BLAD detects air.	1. Use the Air Detector test in Diagnostics to verify the problem. 2. Refer to system schematics and check, repair, or replace all electrical connections associated with the failed air detector. 3. Replace the Adv. Processor PCB. 4. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 5. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.

Table 6-1: Error Messages (Continued)

Error Code	Text Message	Description	Suggested Technical Resolution
6	**AIR DETECTED BY** THE DLAD1	The DLAD1 detects air.	1. Use the Air Detector test in Diagnostics to verify the problem. 2. Refer to system schematics and check, repair, or replace all electrical connections associated with the failed air detector. 3. Replace the Adv. Processor PCB. 4. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 5. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
7	**AIR DETECTED BY** THE DLAD2	The DLAD2 detects air.	1. Use the Air Detector test in Diagnostics to verify the problem. 2. Refer to system schematics and check, repair, or replace all electrical connections associated with the failed air detector. 3. Replace the Adv. Processor PCB. 4. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 5. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
16, 17, 18, 19, 21, 22, 23, 24	**SYSTEM PROBLEM** THE COMPUTER HAS ENCOUNTERED AN ERROR	A CPU error caused the MCS+ to reset.	1. Replace the Adv. Processor PCB. 2. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 3. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.

Table 6-1: Error Messages (Continued)

Error Code	Text Message	Description	Suggested Technical Resolution
25	**CENTRIFUGE PROBLEM** CENTRIFUGE STALL	The Centrifuge encoder signals indicate that the centrifuge stalled.	1. Check bowl for frozen header. 2. Check that the centrifuge rotates freely. 3. Check the +48 volt supply. 4. Refer to the system schematic and check, repair, or replace all electrical connections associated with the centrifuge drive circuit. 5. If the centrifuge does not spin at all, measure the command + signal at P506 on the Adv. Personality PCB. 6. At connector P506, using TP6 system ground, test for +15V at Pin 5. Test for Hall Effect Feedback at Pins 1, 2, and 3, for approximately +6V while manually rotating the centrifuge. 7. At P506, Pins 7, 8, and 9, verify +40V if the centrifuge is turning, and 0 if not. 8. Replace the Adv. Motor Driver PCB. 9. If the signal is incorrect, replace the Adv. Processor PCB. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 10. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values. 11. If the command + signal is OK, replace the centrifuge assembly.

Table 6-1: Error Messages (Continued)

Error Code	Text Message	Description	Suggested Technical Resolution
26	**CENTRIFUGE PROBLEM** THE CENTRIFUGE WAS TURNING TOO FAST	The Centrifuge encoder signals indicate that the spindle speed is 300 RPM greater than the set speed.	1. Using Utilities, display the Centrifuge screen under Diagnostics. Install bowl in centrifuge. Start the centrifuge and measure the actual speed versus the various set speeds. If speeds are incorrect, use calibration to calibrate the speed. 2. If the speed is incorrect, set the speed to 3000 RPM and measure the command + signal at P506 on the Adv. Personality PCB. 3. At connector P506 on the Adv. Personality PCB, using TP6 system ground, test for +15V at Pin 5. Test for Hall Effect Feedback at Pins 1, 2, and 3, for approximately +6V while manually rotating the centrifuge. 4. At P506, Pins 7, 8, and 9, verify +40V if the centrifuge is turning, and 0 if not. 5. Replace the Adv. Motor Driver PCB. 6. If the signal is still incorrect, replace the Adv. Processor PCB. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 7. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values. 8. If the command + signal is OK, replace the centrifuge assembly.

Table 6-1: Error Messages (Continued)

Error Code	Text Message	Description	Suggested Technical Resolution
27	**CENTRIFUGE PROBLEM** THE CENTRIFUGE VACUUM IS NOT DETECTED	The Vacuum switch indicates that the vacuum level is less than an acceptable level during operation (ð9 ±1 psi).	1. Using Utilities, display the centrifuge screen under Diagnostics. Install the bowl in the centrifuge. Measure the actual vacuum level between the vacuum switch and the centrifuge. If the vacuum is less than 8 psi, turn off the pump and check for a pneumatic leak by monitoring the vacuum bleedoff, which should be less than 1 psi/minute. If pneumatic leak is minimal, replace the vacuum pump. 2. If a pneumatic leak exists, isolate the leak to either the centrifuge dump/valve vacuum switch assembly, vacuum pump, or pneum. plumbing. 3. If the centrifuge is at fault, check the L-Gasket and filter ring and then grease with Dow Corning. Check the hydrophobic filter area for any obstruction that would prevent the bowl from seating on the spindle. 4. Isolate the centrifuge internal seal by placing tape over the vacuum hole in the chuck. 5. Replace the centrifuge vacuum seal at the bottom of the centrifuge.
28	**SYSTEM PROBLEM** FLUID HAS BEEN DETECTED IN THE CENTRIFUGE	A leak may have occurred. Fluid was detected in the centrifuge well. **This procedure MUST be discontinued!**	1. If there is fluid in the well, discontinue the procedure, remove the disposable set, and clean the centrifuge well. Return the disposable set to Haemonetics per the RGA policy outline in the *MCS+ Operator's Manual*. 2. If there is no fluid, check all electrical connections. At P504 on the Adv. Personality PCB, check for +15 VDC on the red wire. If the fluid detector is TRUE, voltage should be +9V, if FALSE, voltage should be 0. 3. Replace the fluid detector if the fluid detector indications do not correlate with the voltages.

Table 6-1: Error Messages (Continued)

Error Code	Text Message	Description	Suggested Technical Resolution
29	**SYSTEM PROBLEM** THE COMPUTER HAS ENCOUNTERED AN ERROR	A CPU error, related to the optics system, caused the MCS+ to reset.	1. Using Utilities, display the Transducer screen. Follow the calibration procedure outlined in *Preventive Maintenance* to verify the optics gain. Replace the Adv. Processor PCB. 2. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 3. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
30	**SYSTEM PROBLEM** THE COMPUTER HAS ENCOUNTERED AN ERROR	A CPU error, related to the air sensor, caused the MCS+ to reset.	1. Replace the Adv. Processor PCB. 2. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 3. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.

Table 6-1: Error Messages (Continued)

Error Code	Text Message	Description	Suggested Technical Resolution
31	**CENTRIFUGE PROBLEM** THE CENTRIFUGE SPEED WAS TOO SLOW	The Centrifuge was turning too slowly. The centrifuge encoder signals indicate that the spindle speed is 300 RPM less than the set speed.	1. Check the bowl installation for misaligned base, or check that the bowl seal is not binding by spinning the bowl by hand while holding the bowl header stationary. 2. Using Utilities, display the centrifuge screen under Diagnostics. Install the bowl in the centrifuge and turn on the vacuum pump. Start the centrifuge and measure the actual speed versus various set speeds. If speeds are inaccurate, use calibration to set speed. 3. If the speed is inaccurate, set the speed to 3000 RPM and measure the command + signal at P506 on the Adv. Personality PCB. 4. At connector P506, using TP6 system ground, test for +15V at Pin 5. Test for Hall Effect Feedback at Pins 1, 2, and 3, for approximately +6V while manually rotating the centrifuge. 5. At P506, Pins 7, 8, and 9, verify +40V if the centrifuge is turning, and 0 if not. 6. Replace the Adv. Motor Driver PCB. 7. If the signal is inaccurate, replace the Adv. Processor PCB. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, Serial #. 8. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values. 9. If the command + signal is OK, replace the centrifuge assembly.
32	**SYSTEM PROBLEM** THE COMPUTER HAS ENCOUNTERED AN ERROR	A CPU error, related to the **A/D time-out**, caused the MCS+ to reset.	1. Replace the Adv. Processor PCB. 2. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 3. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
33	**SYSTEM PROBLEM** THE COMPUTER HAS ENCOUNTERED AN ERROR	A CPU error, related to the **queue**, caused the MCS+ to reset.	1. Replace the Adv. Processor PCB. 2. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 3. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.

Table 6-1: Error Messages (Continued)

Error Code	Text Message	Description	Suggested Technical Resolution
34	**SYSTEM PROBLEM** THE COMPUTER HAS ENCOUNTERED AN ERROR	A CPU error, related to **ACK**, caused the MCS+ to reset.	1. Replace the Adv. Processor PCB. 2. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 3. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
35	**SYSTEM PROBLEM** THE COMPUTER HAS ENCOUNTERED AN ERROR	A CPU error, related to the **weigher**, caused the MCS+ to reset.	1. Using Utilities, under Diagnostics, check the weigher calibration and linearity. Calibrate the weigher under A/D if necessary. Replace the load cell if non-linear. 2. Replace CPU.
36	**SYSTEM PROBLEM** THE COMPUTER HAS ENCOUNTERED AN ERROR	A CPU error, related to **"line red,"** caused the MCS+ to reset.	1. Replace the Adv. Processor PCB. 2. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 3. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
37	**AIR DETECTED BY** AIR DETECTED BY SYSTEM MONITOR	The DLAD1 or DLAD2 Air Detector detects air.	1. Use the Air Detector test in Diagnostics to verify the problem in DLAD1 or DLAD2. 2. Refer to system schematics and check, repair, or replace all electrical connections associated with the failed air detector. 3. Replace the Adv. Processor PCB. 4. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 5. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
38	**SYSTEM PROBLEM** THE COMPUTER HAS ENCOUNTERED AN ERROR	A CPU error, related to the **ATOD** converter, caused the MCS+ to reset.	1. Replace the Adv. Processor PCB. 2. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 3. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.

Table 6-1: Error Messages (Continued)

Error Code	Text Message	Description	Suggested Technical Resolution
39	**CENTRIFUGE PROBLEM** THE CENTRIFUGE SPEED WAS TOO SLOW	The Centrifuge was turning too slowly. The centrifuge encoder signals indicate that the spindle speed is 300 RPM less than the set speed.	1. Check the bowl installation for misaligned base, or check that the bowl seal is not binding by spinning the bowl by hand while holding the bowl header stationary. 2. Using Utilities, display the centrifuge screen under Diagnostics. Install the bowl in the centrifuge and turn on the vacuum pump. Start the centrifuge and measure the actual speed versus various set speeds. If speeds are inaccurate, use calibration to set speed. 3. If the speed is inaccurate, set the speed to 3000 RPM and measure the command and signal at P506 on the Adv. Personality PCB. 4. At connector P506, using TP6 system ground, test for +15V at Pin 5. Test for Hall Effect Feedback at Pins 1, 2, and 3, for approximately +6V while manually rotating the centrifuge. 5. At P506, Pins 7, 8, and 9, verify +40V if the centrifuge is turning, and 0 if not. 6. Replace the Adv. Motor Driver PCB. 7. If the signal is inaccurate, replace the Adv. Processor PCB. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 8. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values. 9. If the command + signal is OK, replace the centrifuge assembly.
40	**PUMP PROBLEM** AC PUMP WAS TURNING TOO SLOW	The AC pump encoder signals indicate that the pump is moving slower than the set speed.	1. Swap the motor and encoder plugs on the Top Deck Dist. PCB to isolate the problem. 2. Replace the pump motor, or Adv. Motor Driver, or Adv. Processor PCB. If replacing the Adv. Processor PCB, using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 3. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.

Table 6-1: Error Messages (Continued)

Error Code	Text Message	Description	Suggested Technical Resolution
41	**PUMP PROBLEM** BLOOD PUMP WAS TURNING TOO SLOW	The Blood pump encoder signals indicate that the pump is moving slower than the set speed.	1. Swap the motor and encoder plugs on the Top Deck Dist. PCB to isolate the problem. 2. Replace the pump motor, or Adv. Motor Driver, or Adv. Processor PCB. If replacing the Adv. Processor PCB, using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 3. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
42	**PUMP PROBLEM** WHITE PUMP WAS TURNING TOO SLOW	The White pump encoder signals indicate that the pump is moving slower than the set speed.	1. Swap the motor and encoder plugs on the Top Deck Dist. PCB to isolate the problem. 2. Replace the pump motor, or Adv. Motor Driver, or Adv. Processor PCB. If replacing the Adv. Processor PCB, using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 3. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
44	**PUMP PROBLEM** AC PUMP WAS TURNING TOO FAST	The AC pump encoder signals indicate that the pump is moving faster than the set speed.	1. Swap the motor and encoder plugs on the Top Deck Dist. PCB to isolate the problem. 2. Replace the pump motor, or Adv. Motor Driver, or Adv. Processor PCB. If replacing the Adv. Processor PCB, using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 3. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
45	**PUMP PROBLEM** BLOOD PUMP WAS TURNING TOO FAST	The Blood pump encoder signals indicate that the pump is moving faster than the set speed.	1. Swap the motor and encoder plugs on the Top Deck Dist. PCB to isolate the problem. 2. Replace the pump motor, or Adv. Motor Driver, or Adv. Processor PCB. If replacing the Adv. Processor PCB, using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 3. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.

Table 6-1: Error Messages (Continued)

Error Code	Text Message	Description	Suggested Technical Resolution
46	**PUMP PROBLEM** WHITE PUMP WAS TURNING TOO FAST	The White pump encoder signals indicate that the pump is moving faster than the set speed.	1. Swap the motor and encoder plugs on the Top Deck Dist. PCB to isolate the problem. 2. Replace the pump motor, or Adv. Motor Driver, or Adv. Processor PCB. If replacing the Adv. Processor PCB, using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 3. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
48	**PUMP PROBLEM** AC PUMP WAS TURNING IN THE WRONG DIRECTION	The AC pump encoder signals indicate that the pump is moving in the wrong direction.	1. Swap the motor and encoder plugs on the Top Deck Dist. PCB to isolate the problem. 2. Replace the pump motor, or Adv. Motor Driver, or Adv. Processor PCB. If replacing the Adv. Processor PCB, using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 3. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
49	**PUMP PROBLEM** BLOOD PUMP WAS TURNING IN THE WRONG DIRECTION	The Blood pump encoder signals indicate that the pump is moving in the wrong direction.	1. Swap the motor and encoder plugs on the Top Deck Dist. PCB to isolate the problem. 2. Replace the pump motor, or Adv. Motor Driver, or Adv. Processor PCB. If replacing the Adv. Processor PCB, using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 3. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
50	**PUMP PROBLEM** WHITE PUMP WAS TURNING IN THE WRONG DIRECTION	The White pump encoder signals indicate that the pump is moving in the wrong direction.	1. Swap the motor and encoder plugs on the Top Deck Dist. PCB to isolate the problem. 2. Replace the pump motor, or Adv. Motor Driver, or Adv. Processor PCB. If replacing the Adv. Processor PCB, using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 3. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.

Table 6-1: Error Messages (Continued)

Error Code	Text Message	Description	Suggested Technical Resolution
52	**PUMP PROBLEM** AC PUMP POSITION IS NOT CORRECT	The Advanced Motor Driver PCB indicates that the AC pump position is 128 counts ahead or lagging from the set pump position.	1. Swap the motor and encoder plugs on the Top Deck Dist. PCB to isolate the problem. 2. Replace the pump motor, or Adv. Motor Driver, or Adv. Processor PCB. If replacing the Adv. Processor PCB, using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 3. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
53	**PUMP PROBLEM** BLOOD PUMP POSITION IS NOT CORRECT	The Advanced Motor Driver PCB indicates that the Blood pump position is 128 counts ahead or lagging from the set pump position.	1. Swap the motor and encoder plugs on the Top Deck Dist. PCB to isolate the problem. 2. Replace the pump motor, or Adv. Motor Driver, or Adv. Processor PCB. If replacing the Adv. Processor PCB, using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 3. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
54	**PUMP PROBLEM** WHITE PUMP POSITION IS NOT CORRECT	The Advanced Motor Driver PCB indicates that the White pump position is 128 counts ahead or lagging from the set pump position.	1. Swap the motor and encoder plugs on the Top Deck Dist. PCB to isolate the problem. 2. Replace the pump motor, or Adv. Motor Driver, or Adv. Processor PCB. If replacing the Adv. Processor PCB, using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 3. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
56	**PUMP PROBLEM** THE AC/BLOOD PUMP RATIO IS INCORRECT	An occlusion may have occurred at the AC or Blood Pump.	1. Check both pumps for occlusions. 2. Swap the motor and encoder plugs on the Top Deck Dist. PCB to isolate the problem. 3. Replace the pump motor, or Adv. Motor Driver, or Adv. Processor PCB. If replacing the Adv. Processor PCB, using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 4. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.

Table 6-1: Error Messages (Continued)

Error Code	Text Message	Description	Suggested Technical Resolution
57	**PUMP PROBLEM** THE AC/BLOOD PUMP RATIO IS INCORRECT	An occlusion may have occurred at the AC or Blood Pump.	1. Check both pumps for occlusions. 2. Swap the motor and encoder plugs on the Top Deck Dist. PCB to isolate the problem. 3. Replace the pump motor, or Adv. Motor Driver, or Adv. Processor PCB. If replacing the Adv. Processor PCB, using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 4. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.

Table 6-1: Error Messages (Continued)

Error Code	Text Message	Description	Suggested Technical Resolution
58	**VALVE PROBLEM** THE RED VALVE WAS DETECTED OUT OF POSITION	The Red Valve was detected out of position.	1. Use the valve test in Diagnostics to manually transition the valves and monitor the valve switch and response. The valve position is normally closed (approx. 0 volts), and when open, +5 VDC can be measured on the black wire terminal. Power to the pinch valve should be +5 volts on the brown wire. 2. Swap valve connections at the Top Deck Dist. PCB to isolate the problem to the valve circuit. Replace the valve if necessary. 3. If the problem is not resolved, refer to the system schematic and check, repair, or replace all connections associated with the valve circuit. 4. Replace the Adv. Valve Driver PCB, or Adv. Processor PCB. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 5. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values. 6. Check all pneumatic and electrical connections on valve compressor. 7. Install the Bio-Tek Pressure Meter in line with the compressor to measure the psi. It should maintain a pressure of 20-25 psi. 8. Test for +15 volts at Pin 4 (red wire) of P614 on the Top Deck Dist. PCB. (Use SYSGND on the Adv. Personality PCB.) Reference system schematic sheet 6 of 6 and Drawing 37187-00 (Top Deck Dist. PCB). 9. If voltage is present, check Pin 1 (black wire) of P614 on the Top Deck Dist. PCB for 28 volts. 10. If voltages are present at P614, test the pneumatics module for voltages and inspect the cable for connection issues. 11. If the cable has no problems and the voltages are present, replace the pneumatics module.

Table 6-1: Error Messages (Continued)

Error Code	Text Message	Description	Suggested Technical Resolution
59	**PUMP PROBLEM** THE AC/BLOOD PUMP RATIO IS TOO LOW	An occlusion may have occurred at the AC or Blood Pump.	1. Check both pumps for occlusions. 2. Swap the motor and encoder plugs on the Top Deck Dist. PCB to isolate the problem. 3. Replace the pump motor, or Adv. Motor Driver, or Adv. Processor PCB. If replacing the Adv. Processor PCB, using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 4. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
60	**PUMP PROBLEM** THE AC/BLOOD PUMP RATIO IS TOO HIGH	An occlusion may have occurred at the AC or Blood Pump.	1. Check both pumps for occlusions. 2. Swap the motor and encoder plugs on the Top Deck Dist. PCB to isolate the problem. 3. Replace the pump motor, or Adv. Motor Driver, or Adv. Processor PCB. If replacing the Adv. Processor PCB, using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 4. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
61	**SYSTEM PROBLEM** THE COMPUTER HAS ENCOUNTERED AN ERROR	A CPU error, related to the ATOD failure, caused the MCS+ to reset.	1. Replace the Adv. Processor PCB. 2. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 3. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
62	**ECV LIMIT** THE DONOR ECV LIMIT IS REACHED	Extra Corporeal Volume (ECV) warning is executed at 690 ml.	1. This message could occur if the hematocrit of the donor's blood is very low, or if the blood efficiency is negatively affected by a flow restriction, or a problem pertaining to the pump rotor. 2. Conduct a flow test on the blood pump. Replace the blood pump rotor if efficiency is less than ±10% of set volume.
63	**SYSTEM PROBLEM** THE SAFETY SYSTEM HAS ENCOUNTERED AN ERROR	A CPU error, related to the Time Base Safety Fault, caused the MCS+ to reset.	1. Replace the Adv. Motor Driver PCB. 2. Replace the Adv. Safety PCB. 3. Replace the Adv. Processor PCB. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 4. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.

Table 6-1: Error Messages (Continued)

Error Code	Text Message	Description	Suggested Technical Resolution
64	**SYSTEM PROBLEM** THE SAFETY SYSTEM HAS ENCOUNTERED AN ERROR	A Watchdog error caused the MCS+ to reset.	1. Replace the Adv. Motor Driver PCB. 2. Replace the Adv. Safety PCB. 3. Replace the Adv. Processor PCB. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 4. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
65	**SYSTEM PROBLEM** THE SAFETY SYSTEM HAS ENCOUNTERED AN ERROR	A DPM/SPM connector caused the MCS+ to reset.	1. Refer to the system schematic and check, repair, or replace all electrical connections associated with the DPM and SPM. 2. Use Diagnostics to check DPM and SPM interlocks. Check that filter sleeve is properly installed in DPM and SPM. Replace DPM and SPM if problem found. 3. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, Safety System, and Serial #. 4. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values. 5. Replace the Adv. Motor Driver PCB.
66	**SYSTEM PROBLEM** THE SAFETY SYSTEM HAS ENCOUNTERED AN ERROR	A pressure fault caused the MCS+ to reset.	1. This error usually occurs from a pressure spike. Verify the DPM/SPM calibration.
67	**SYSTEM PROBLEM** THE SAFETY SYSTEM HAS ENCOUNTERED AN ERROR	An Air Detector caused the MCS+ to reset.	1. Use the Air Detector test in Diagnostics to verify the problem. 2. Refer to system schematics and check, repair, or replace all electrical connections associated with the failed air detector. 3. Replace the Adv. Motor Driver PCB. 4. Replace the Adv. Processor PCB. 5. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 6. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.

Table 6-1: Error Messages (Continued)

Error Code	Text Message	Description	Suggested Technical Resolution
68	**SYSTEM PROBLEM** THE SAFETY SYSTEM HAS ENCOUNTERED AN ERROR	Generally, the blood pump feedback to the safety board creates this fault. The safety pcb was re-designed to address this fault. P/N 86158-01	1. Power off the MCS+, then power on again. 2. If error message occurs again, replace the Adv. Safety PCB. 3. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 4. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
69	**SYSTEM PROBLEM** THE SAFETY SYSTEM HAS ENCOUNTERED AN ERROR	Extra Corporeal Volume (ECV) warning is executed at 690 ml.	This message could occur if the hematocrit of the donor's blood is very low, or if the blood efficiency is negatively affected by a flow restriction, or there is a problem pertaining to the pump rotor. 1. Conduct a flow test on the blood pump. Replace the blood pump rotor if efficiency is less than ±10% of set volume. 2. If problem persists, replace the Adv. Motor Driver PCB.
70	**SYSTEM PROBLEM** THE SAFETY SYSTEM HAS ENCOUNTERED AN ERROR	A ratio fault caused the MCS+ to reset. An occlusion may have occurred at the AC or Blood Pump.	1. Check both pumps for occlusions. 2. Swap the motor and encoder plugs on the Top Deck Dist. PCB to isolate the problem. 3. Replace the pump motor, or Adv. Motor Driver, or Adv. Processor PCB. If replacing the Adv. Processor PCB, using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 4. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.

Table 6-1: Error Messages (Continued)

Error Code	Text Message	Description	Suggested Technical Resolution
71	**SYSTEM PROBLEM** THE SAFETY SYSTEM HAS ENCOUNTERED AN ERROR	A pump motor caused the MCS+ to reset.	1. Inspect the Blood Pump Rotor for binding rollers. Clean if necessary. 2. Inspect the motor generator for free movement, no binding. 3. Measure all power supplies at the Adv. Personality PCB test points. (Remove the Front Panel to gain access.) If no problem is found with the power supplies, go to Step 5. 4. Inspect the main power cord, power entry module fuses and AC power at the line filter. Test the power supplies at P1 of the Power Supply. (See system schematic for pin out, sheet 1 of 3.) If no power is present, test the internal fuse of the power supply. If no problem is found with the fuse, replace the power supply. 5. Swap the power and encoder cables. If the problem follows the pumps, inspect the cables. If a problem exists, repair or replace the pump. If there are no issues with the cables, replace the pump. 6. If no pump problem, test for P3 for +5 and P1 for +28 Volts at P619 on the Top Deck Dist. PCB. Use the ground test point at the Adv. Personality PCB. Refer to the system schematic. 7. Test for pump voltages at P603 of the Top Deck Dist. PCB, pins 2, 3, and 4 for +28 volts. If power is not present, test the cable for continuity. Replace cable if defective. 8. If no cables issues are found, install a new Adv. Motor Driver PCB and test the system.
72	**SYSTEM PROBLEM** THE SAFETY SYSTEM HAS ENCOUNTERED AN ERROR	A prime error caused the MCS+ to reset.	1. Check the tubing installation at all pumps. 2. Check for proper installation of the disposable. 3. Check the air detectors under Diagnostics. 4. Replace the Adv. Processor PCB. 5. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 6. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values. 7. Replace the Adv. Safety PCB. 8. Replace the Adv. Motor Driver PCB.

Table 6-1: Error Messages (Continued)

Error Code	Text Message	Description	Suggested Technical Resolution
73	**SYSTEM PROBLEM** THE SAFETY SYSTEM HAS ENCOUNTERED AN ERROR	A power interruption caused the MCS+ to reset.	1. After power-up, if the MCS+ does not reset, inspect and check the power supplies. 2. Inspect the main power cord, power entry module fuses and AC power at the line filter. Test the power supplies at P1 of the Power Supply. (See system schematic for pin out, sheet 1 of 3.) If no power is present, test the internal fuse of the power supply. If no problem is found with the fuse, replace the power supply. 3. Replace the power supplies. 4. Replace the Adv. Processor PCB. 5. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 6. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values. 7. If problem persists, replace the Adv. Motor Driver PCB.
74	**SYSTEM PROBLEM** THE COMPUTER HAS ENCOUNTERED AN ERROR	A CPU error, related to a division by zero fault, caused the MCS+ to reset.	1. Replace the Adv. Processor PCB. 2. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 3. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
75	**SYSTEM PROBLEM** THE COMPUTER HAS ENCOUNTERED AN ERROR	A CPU error, related to the single step, caused the MCS+ to reset.	1. Replace the Adv. Processor PCB. 2. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 3. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
76	**SYSTEM PROBLEM** THE COMPUTER HAS ENCOUNTERED AN ERROR	A CPU error, related to the NMI, caused the MCS+ to reset.	1. Replace the Adv. Processor PCB. 2. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 3. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
77	**SYSTEM PROBLEM** THE COMPUTER HAS ENCOUNTERED AN ERROR	A CPU error, related to breakpoint, caused the MCS+ to reset.	1. Replace the Adv. Processor PCB. 2. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 3. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.

Table 6-1: Error Messages (Continued)

Error Code	Text Message	Description	Suggested Technical Resolution
78	**SYSTEM PROBLEM** THE COMPUTER HAS ENCOUNTERED AN ERROR	A CPU error, related to overflow, caused the MCS+ to reset.	1. Replace the Adv. Processor PCB. 2. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 3. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
79	**SYSTEM PROBLEM** THE COMPUTER HAS ENCOUNTERED AN ERROR	A CPU error, related to array bounds, caused the MCS+ to reset.	1. Replace the Adv. Processor PCB. 2. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 3. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
80	**SYSTEM PROBLEM** THE COMPUTER HAS ENCOUNTERED AN ERROR	A CPU error, related to an invalid opcode caused the MCS+ to reset.	1. Replace the Adv. Processor PCB. 2. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 3. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
81	**SYSTEM PROBLEM** THE COMPUTER HAS ENCOUNTERED AN ERROR	A CPU error, related to Escape, caused the MCS+ to reset.	1. Replace the Adv. Processor PCB. 2. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 3. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
82	**SYSTEM PROBLEM** THE COMPUTER HAS ENCOUNTERED AN ERROR	A CPU error, related to the timer, caused the MCS+ to reset.	1. Replace the Adv. Processor PCB. 2. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 3. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
83	**SYSTEM PROBLEM** THE COMPUTER HAS ENCOUNTERED AN ERROR	A CPU error, related to the DMA, caused the MCS+ to reset.	1. Replace the Adv. Processor PCB. 2. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 3. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
84	**SYSTEM PROBLEM** THE COMPUTER HAS ENCOUNTERED AN ERROR	A CPU error, related to the Air ISR, caused the MCS+ to reset.	1. Replace the Adv. Processor PCB. 2. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 3. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.

Table 6-1: Error Messages (Continued)

Error Code	Text Message	Description	Suggested Technical Resolution
85	**SYSTEM PROBLEM** THE COMPUTER HAS ENCOUNTERED AN ERROR	A CPU error, related to the INT ISR, caused the MCS+ to reset.	1. Replace the Adv. Processor PCB. 2. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 3. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
86	**SYSTEM PROBLEM** THE COMPUTER HAS ENCOUNTERED AN ERROR	A CPU error, related to a double fault, caused the MCS+ to reset.	1. Replace the Adv. Processor PCB. 2. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 3. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
87	**SYSTEM PROBLEM** THE COMPUTER HAS ENCOUNTERED AN ERROR	A CPU error, related to the coprocessor being overrun, caused the MCS+ to reset.	1. Replace the Adv. Processor PCB. 2. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 3. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
88	**SYSTEM PROBLEM** THE COMPUTER HAS ENCOUNTERED AN ERROR	A CPU error, related to an invalid TSS, caused the MCS+ to reset.	1. Replace the Adv. Processor PCB. 2. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 3. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
89	**SYSTEM PROBLEM** THE COMPUTER HAS ENCOUNTERED AN ERROR	A CPU error, related to the segment, caused the MCS+ to reset.	1. Replace the Adv. Processor PCB. 2. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 3. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
90	**SYSTEM PROBLEM** THE COMPUTER HAS ENCOUNTERED AN ERROR	A CPU error, related to a stack fault, caused the MCS+ to reset.	1. Replace the Adv. Processor PCB. 2. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 3. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
91	**SYSTEM PROBLEM** THE COMPUTER HAS ENCOUNTERED AN ERROR	A CPU error, General Protection Fault, caused the MCS+ to reset.	1. Replace the Adv. Processor PCB. 2. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 3. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.

Table 6-1: Error Messages (Continued)

Error Code	Text Message	Description	Suggested Technical Resolution
92	**SYSTEM PROBLEM** THE COMPUTER HAS ENCOUNTERED AN ERROR	A CPU error, relating to a page fault, caused the MCS+ to reset.	1. Replace the Adv. Processor PCB. 2. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 3. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
93	**SYSTEM PROBLEM** THE COMPUTER HAS ENCOUNTERED AN ERROR	A CPU error, related to the coprocessor being overrun, caused the MCS+ to reset.	1. Replace the Adv. Processor PCB. 2. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 3. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
94	**SYSTEM PROBLEM** THE COMPUTER HAS ENCOUNTERED AN ERROR	A CPU error, related to an unexpected INT, caused the MCS+ to reset.	1. Replace the Adv. Processor PCB. 2. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 3. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
100	**CENTRIFUGE PROBLEM** CENTRIFUGE SAFETY SWITCH NOT OPERATIONAL	The Centrifuge safety switch must be operational to operate the MCS+.	1. Turn power off and on again. 2. Replace the Adv. Motor Driver PCB.
101	**PROCESS PROBLEM** RETURN CYCLE TAKING TOO LONG	Emptying the bowl took longer than expected; an occlusion may have occurred.	1. Check tubing at pumps and bowl. 2. Check bowl. 3. Check to see if the Blood pump efficiency is negatively affected by a flow restriction or some problem with the pump rotor. 4. Conduct a flow test on the Blood pump. Replace the Blood pump rotor if efficiency is less than ±10 of set volume.
102	**PROCESS PROBLEM** AIR DETECTED EARLIER THAN EXPECTED	Emptying the bowl took less time than expected.	1. Check the tubing at the BLAD. 2. Check the bowl for occlusions. 3. Use the Air Detector test in Diagnostics to verify the problem. 4. Refer to system schematics and check, repair, or replace all electrical connections associated with the failed air detector. 5. Replace the Adv. Processor PCB. 6. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 7. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.

Table 6-1: Error Messages (Continued)

Error Code	Text Message	Description	Suggested Technical Resolution
103	**NO AC FLOW** LOW AC FLOW DETECTED BY DRIP MONITOR	Low AC flow detected by Drip Monitor; dripping too slow.	1. Check that the AC bag contains fluid. 2. Check the AC tubing for occlusions and clamps. 3. Check the installation of the Drip Chamber and the fluid level. 4. Inspect all electrical connections associated with the drip monitor. 5. Test Pin 6 of P616 on the Top Deck Dist. PCB for +5 volts. 6. Perform Drip Monitor Test Diagnostics. (See Preventive Maintenance chapter.) 7. If the test fails, replace the Drip Monitor assembly. 8. Replace the Adv. Processor PCB. 9. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 10. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
104	**NO AC FLOW** HIGH AC FLOW DETECTED BY DRIP MONITOR	High AC flow detected by Drip Monitor; dripping too fast.	1. Check tubing at AC pump. 2. Check installation of Drip Chamber and fluid level. 3. Inspect all electrical connections associated with the drip monitor. 4. Test Pin 6 of P616 on the Top Deck Dist. PCB for +5 volts. 5. Perform Drip Monitor Test Diagnostics. (see Preventive Maintenance chapter.) 6. If the test fails, replace the Drip Monitor assembly. 7. Replace the Adv. Processor PCB. 8. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 9. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.

Table 6-1: Error Messages (Continued)

Error Code	Text Message	Description	Suggested Technical Resolution
105	**NO AC FLOW** NO AC FLOW DETECTED BY DRIP MONITOR	No AC flow was detected by the Drip Monitor.	1. Inspect all electrical connections associated with the drip monitor. 2. Test Pin 6 of P616 on the Top Deck Dist. PCB for +5 volts. 3. Perform Drip Monitor Test Diagnostics. (see Preventive Maintenance chapter.) 4. If the test fails, replace the Drip Monitor assembly. 5. Replace the Adv. Processor PCB. 6. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 7. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
106	**SYSTEM PROBLEM** NO CUFF PRESSURE DETECTED	No cuff pressure was detected.	1. Inspect all electrical and pneumatic connections related to the cuff (refer to the system schematics). 2. Test the cuff operation under Pressure Diagnostics. 3. If cuff is out of calibration, recalibrate according to the Preventive Maintenance chapter on cuff calibration. 4. If compressor is still not operational, replace the cuff compressor assembly.
107	**PROCESS PROBLEM** NO AIR PLASMA INTERFACE DETECTED	No air plasma interface was detected.	1. Using Utilities, enter Diagnostics/Transducers. 2. Perform the Optics Test (see Preventive Maintenance chapter). 3. If the optics are out of calibration, recalibrate according to the calibration procedure. 4. If the Offset or Gray card readings are out of specification, inspect for particulate. 5. Test for +15 volts on P1 of P597 on the Adv. Personality PCB. 6. If the voltage is within specification, replace the optics block. 7. Replace the Banner Unit. 8. Replace the Adv. Processor PCB. 9. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 10. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.

Table 6-1: Error Messages (Continued)

Error Code	Text Message	Description	Suggested Technical Resolution
223	**CENTRIFUGE PROBLEM** THE CENTRIFUGE COVER IS NOT LOCKED	The Centrifuge cover latch switches indicate that the cover is open or unlocked in the beginning or during Draw.	1. Install a bowl into the centrifuge and check that the centrifuge cover halves are completely closed, and that the bowl header is properly aligned in the centrifuge cover halves. Listen for two distinctive clicks from the microswitches when the cover latch knob secures the cover halves. 2. Close and latch the cover halves and measure +28 VDC on P503, Pin 2 and +15 VDC on Pin 3 of the Adv. Personality PCB. If no signal exists, check the alignment of the centrifuge cover latch microswitches and adjust accordingly. 3. If a signal exists, the CPU is not responding, refer to the system schematics and check, repair, or replace all electrical connections associated with the centrifuge cover switch signals. 4. Replace the Adv. Processor PCB. 5. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 6. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.

Table 6-1: Error Messages (Continued)

Error Code	Text Message	Description	Suggested Technical Resolution
224	**VALVE PROBLEM** THE PURPLE VALVE WAS DETECTED OUT OF POSITION	The Purple Valve was detected out of position.	1. Use the valve test in Diagnostics to manually transition the valves and monitor the valve switch and response. The valve position is normally closed (approx. 0 volts), and when open, -5 VDC can be measured on the black wire terminal. Power to the pinch valve should be +5 volts on the brown wire. 2. Swap valve connections at the Top Deck Dist. PCB to isolate the problem to the valve circuit. Replace the valve if necessary. 3. If the valve does not move, refer to the system schematic and check, repair, or replace all connections associated with the valve circuit. 4. Replace the Adv. Valve Driver PCB, or Adv. Processor PCB. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 5. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values. 6. Check all pneumatic and electrical connections on valve compressor. 7. Install the Bio-Tek Pressure Meter in line with the compressor to measure the psi. It should maintain a pressure of 20-25 psi. 8. Test for +15 volts at Pin 4 (red wire) of P614 on the Top Deck Dist. PCB. (Use SYSGND on the Adv. Personality PCB.) Reference system schematic sheet 6 of 6 and Drawing 37187-00 (Top Deck Dist. PCB). 9. If voltage is present, check Pin 1 (black wire) of P614 on the Top Deck Dist. PCB for 28 volts. 10. If voltages are present at P614, test the pneumatics module for voltages and inspect the cable for connection issues. 11. If the cable has no problems and the voltages are present, replace the pneumatics module.

Table 6-1: Error Messages (Continued)

Error Code	Text Message	Description	Suggested Technical Resolution
225	**VALVE PROBLEM** THE ORANGE VALVE WAS DETECTED OUT OF POSITION	The Orange Valve was detected out of position.	1. Use the valve test in Diagnostics to manually transition the valves and monitor the valve switch and response. The valve position is normally closed (approx. 0 volts), and when open, -5 VDC can be measured on the black wire terminal. Power to the pinch valve should be +5 volts on the brown wire. 2. Swap valve connections at the Top Deck Dist.PCB to isolate the problem to the valve circuit. Replace the valve if necessary. 3. If the valve does not move, refer to the system schematic and check, repair, or replace all connections associated with the valve circuit. 4. Replace the Adv. Valve Driver PCB, or Adv. Processor PCB. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 5. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values. 6. Check all pneumatic and electrical connections on valve compressor. 7. Install the Bio-Tek Pressure Meter in line with the compressor to measure the psi. It should maintain a pressure of 20-25 psi. 8. Test for +15 volts at Pin 4 (red wire) of P614 on the Top Deck Dist. PCB. (Use SYSGND on the Adv. Personality PCB.) Reference system schematic sheet 6 of 6 and Drawing 37187-00 (Top Deck Dist. PCB). 9. If voltage is present, check Pin 1 (black wire) of P614 on the Top Deck Dist. PCB for 28 volts. 10. If voltages are present at P614, test the pneumatics module for voltages and inspect the cable for connection issues. 11. If the cable has no problems and the voltages are present, replace the pneumatics module.

Table 6-1: Error Messages (Continued)

Error Code	Text Message	Description	Suggested Technical Resolution
226	**VALVE PROBLEM** THE BLUE VALVE WAS DETECTED OUT OF POSITION	The Blue Valve was detected out of position.	1. Use the valve test in Diagnostics to manually transition the valves and monitor the valve switch and response. The valve position is normally closed (approx. 0 volts), and when open, -5 VDC can be measured on the black wire terminal. Power to the pinch valve should be +5 volts on the brown wire. 2. Swap valve connections at the Top Deck Dist. PCB to isolate the problem to the valve circuit. Replace the valve if necessary. 3. If the valve does not move, refer to the system schematic and check, repair, or replace all connections associated with the valve circuit. 4. Replace the Adv. Valve Driver PCB, or Adv. Processor PCB. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 5. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values. 6. Check all pneumatic and electrical connections on valve compressor. 7. Install the Bio-Tek Pressure Meter in line with the compressor to measure the psi. It should maintain a pressure of 20-25 psi. 8. Test for +15 volts at Pin 4 (red wire) of P614 on the Top Deck Dist. PCB. (Use SYSGND on the Adv. Personality PCB.) Reference system schematic sheet 6 of 6 and Drawing 37187-00 (Top Deck Dist. PCB). 9. If voltage is present, check Pin 1 (black wire) of P614 on the Top Deck Dist. PCB for 28 volts. 10. If voltages are present at P614, test the pneumatics module for voltages and inspect the cable for connection issues. 11. If the cable has no problems and the voltages are present, replace the pneumatics module.

Table 6-1: Error Messages (Continued)

Error Code	Text Message	Description	Suggested Technical Resolution
227	**VALVE PROBLEM** THE YELLOW VALVE WAS DETECTED OUT OF POSITION	The Yellow Valve was detected out of position.	1. Use the valve test in Diagnostics to manually transition the valves and monitor the valve switch and response. The valve position is normally closed (approx. 0 volts), and when open, -5 VDC can be measured on the black wire terminal. Power to the pinch valve should be +5 volts on the brown wire. 2. Swap valve connections at the Top Deck Dist. PCB to isolate the problem to the valve circuit. Replace the valve if necessary. 3. If the valve does not move, refer to the system schematic and check, repair, or replace all connections associated with the valve circuit. 4. Replace the Adv. Valve Driver PCB, or Adv. Processor PCB. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 5. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values. 6. Check all pneumatic and electrical connections on valve compressor. 7. Install the Bio-Tek Pressure Meter in line with the compressor to measure the psi. It should maintain a pressure of 20-25 psi. 8. Test for +15 volts at Pin 4 (red wire) of P614 on the Top Deck Dist. PCB. (Use SYSGND on the Adv. Personality PCB.) Reference system schematic sheet 6 of 6 and Drawing 37187-00 (Top Deck Dist. PCB). 9. If voltage is present, check Pin 1 (black wire) of P614 on the Top Deck Dist. PCB for 28 volts. 10. If voltages are present at P614, test the pneumatics module for voltages and inspect the cable for connection issues. 11. If the cable has no problems and the voltages are present, replace the pneumatics module.

Table 6-1: Error Messages (Continued)

Error Code	Text Message	Description	Suggested Technical Resolution
228	**VALVE PROBLEM** THE WHITE VALVE WAS DETECTED OUT OF POSITION	The White Valve was detected out of position.	1. Use the valve test in Diagnostics to manually transition the valves and monitor the valve switch and response. The valve position is normally closed (approx. 0 volts), and when open, -5 VDC can be measured on the black wire terminal. Power to the pinch valve should be +5 volts on the brown wire. 2. Swap valve connections at the Top Deck Dist. PCB to isolate the problem to the valve circuit. Replace the valve if necessary. 3. If the valve does not move, refer to the system schematic and check, repair, or replace all connections associated with the valve circuit. 4. Replace the Adv. Valve Driver PCB, or Adv. Processor PCB. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 5. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values. 6. Check all pneumatic and electrical connections on valve compressor. 7. Install the Bio-Tek Pressure Meter in line with the compressor to measure the psi. It should maintain a pressure of 20-25 psi. 8. Test for +15 volts at Pin 4 (red wire) of P614 on the Top Deck Dist. PCB. (Use SYSGND on the Adv. Personality PCB.) Reference system schematic sheet 6 of 6 and Drawing 37187-00 (Top Deck Dist. PCB). 9. If voltage is present, check Pin 1 (black wire) of P614 on the Top Deck Dist. PCB for 28 volts. 10. If voltages are present at P614, test the pneumatics module for voltages and inspect the cable for connection issues. 11. If the cable has no problems and the voltages are present, replace the pneumatics module.

Table 6-1: Error Messages (Continued)

Error Code	Text Message	Description	Suggested Technical Resolution
229	**VALVE PROBLEM** THE GREEN VALVE WAS DETECTED OUT OF POSITION	The Green Valve was detected out of position.	1. Use the valve test in Diagnostics to manually transition the valves and monitor the valve switch and response. The valve position is normally closed (approx. 0 volts), and when open, -5 VDC can be measured on the black wire terminal. Power to the pinch valve should be +5 volts on the brown wire. 2. Swap valve connections at the Top Deck Dist. PCB to isolate the problem to the valve circuit. Replace the valve if necessary. 3. If the valve does not move, refer to the system schematic and check, repair, or replace all connections associated with the valve circuit. 4. Replace the Adv. Valve Driver PCB, or Adv. Processor PCB. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 5. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values. 6. Check all pneumatic and electrical connections on valve compressor. 7. Install the Bio-Tek Pressure Meter in line with the compressor to measure the psi. It should maintain a pressure of 20-25 psi. 8. Test for +15 volts at Pin 4 (red wire) of P614 on the Top Deck Dist. PCB. (Use SYSGND on the Adv. Personality PCB.) Reference system schematic sheet 6 of 6 and Drawing 37187-00 (Top Deck Dist. PCB). 9. If voltage is present, check Pin 1 (black wire) of P614 on the Top Deck Dist. PCB for 28 volts. 10. If voltages are present at P614, test the pneumatics module for voltages and inspect the cable for connection issues. 11. If the cable has no problems and the voltages are present, replace the pneumatics module.

Table 6-1: Error Messages (Continued)

Error Code	Text Message	Description	Suggested Technical Resolution
252	**SYSTEM PROBLEM** THE COMPUTER HAS ENCOUNTERED AN ERROR	A CPU error, related to pressure failure, caused the MCS+ to reset.	1. Replace the Adv. Processor PCB. 2. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 3. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.

Table 6-1: Error Messages (Continued)

Error Code	Text Message	Description	Suggested Technical Resolution
254	**VALVE PROBLEM** THE RED VALVE WAS DETECTED OUT OF POSITION	The Red Valve (Donor) was detected out of position.	1. Use the valve test in Diagnostics to manually transition the valves and monitor the valve switch and response. The valve position is normally closed (approx. 0 volts), and when open, -5 VDC can be measured on the black wire terminal. Power to the pinch valve should be +5 volts on the brown wire. 2. Swap valve connections at the Top Deck Dist. PCB to isolate the problem to the valve circuit. Replace the valve if necessary. 3. If the valve does not move, refer to the system schematic and check, repair, or replace all connections associated with the valve circuit. 4. Replace the Adv. Valve Driver PCB, or Adv. Processor PCB. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 5. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values. 6. Check all pneumatic and electrical connections on valve compressor. 7. Install the Bio-Tek Pressure Meter in line with the compressor to measure the psi. It should maintain a pressure of 20-25 psi. 8. Test for +15 volts at Pin 4 (red wire) of P614 on the Top Deck Dist. PCB. (Use SYSGND on the Adv. Personality PCB.) Reference system schematic sheet 6 of 6 and Drawing 37187-00 (Top Deck Dist. PCB). 9. If voltage is present, check Pin 1 (black wire) of P614 on the Top Deck Dist. PCB for 28 volts. 10. If voltages are present at P614, test the pneumatics module for voltages and inspect the cable for connection issues. 11. If the cable has no problems and the voltages are present, replace the pneumatics module.

Table 6-1: Error Messages (Continued)

Error Code	Text Message	Description	Suggested Technical Resolution
255	**CONNECTOR** THE DPM FILTER HAS BEEN DISCONNECTED	The DPM filter has been disconnected.	1. Refer to the system schematics and check, repair, or replace all electrical connections associated with the DPM and SPM. 2. Use Diagnostics to check the DPM and SPM interlocks. Check that the filter sleeve is properly installed in the DPM and SPM. Replace the DPM and SPM if a problem is found. Use Utilities to recalibrate A/D and the safety system. 3. Replace the Adv. Processor PCB. 4. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 5. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
256	**CONNECTOR** THE SPM FILTER HAS BEEN DISCONNECTED	The SPM filter has been disconnected.	1. Refer to the system schematics and check, repair, or replace all electrical connections associated with the DPM and SPM. 2. Use Diagnostics to check the DPM and SPM interlocks. Check that the filter sleeve is properly installed in the DPM and SPM. Replace the DPM and SPM if a problem is found. Use Utilities to recalibrate A/D and the safety system. 3. Replace the Adv. Processor PCB. 4. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 5. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values. 6. If problem persists, replace the Adv. Motor Driver PCB.

Table 6-1: Error Messages (Continued)

Error Code	Text Message	Description	Suggested Technical Resolution
257	**PRESSURE PROBLEM** HIGH PRESSURE ERROR AT THE DPM	The DPM high pressure limit was exceeded.	1. Using Diagnostics, load the DPM for high pressure and measure the DPM signal at P609, Pin 7 of the Top Deck Dist. PCB. Acceptable range for high reading is 3.98 to 4.98 VDC (3260-4080). 2. Test the calibration of the DPM according to the procedures listed in the Preventive Maintenance chapter. Recalibrate if necessary. 3. Inspect all connections associated with the DPM. 4. Replace the DPM assembly if necessary. 5. Replace the Adv. Processor PCB. 6. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 7. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
258	**PRESSURE PROBLEM** LOW PRESSURE ERROR AT THE DPM	The DPM low pressure limit was exceeded.	1. Using Diagnostics, load the DPM for high pressure and measure the DPM signal at P609, Pin 7 of the Top Deck Dist. PCB. Acceptable range for high reading is 3.98 to 4.98 VDC (3260-4080). 2. Test the calibration of the DPM according to the procedures listed in the Preventive Maintenance chapter. Recalibrate if necessary. 3. Inspect all connections associated with the DPM. 4. Replace the DPM assembly if necessary. 5. Replace the Adv. Processor PCB. 6. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 7. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.

Table 6-1: Error Messages (Continued)

Error Code	Text Message	Description	Suggested Technical Resolution
259	**PRESSURE PROBLEM** SPM HIGH PRESSURE ERROR	The SPM high pressure limit was exceeded.	1. Using Diagnostics, load the SPM for high pressure and measure the SPM signal at P608, Pin 7 of the Top Deck Dist. PCB. Acceptable range for high reading is 3.98 to 4.98 VDC (3260-4080). 2. Test the calibration of the SPM according to the procedures listed in the Preventive Maintenance chapter. Recalibrate if necessary. 3. Inspect all connections associated with the SPM. 4. Replace the SPM assembly if necessary. 5. Replace the Adv. Processor PCB. 6. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 7. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
260	**PRESSURE PROBLEM** THE SPM PRESSURE WAS TOO LOW	The SPM low pressure limit was exceeded.	1. Using Diagnostics, load the SPM for low pressure and measure the SPM signal at P608, Pin 7 of the Top Deck Dist. PCB. Acceptable range for high reading is 3.98 to 4.98 VDC (3260-4080). 2. Test the calibration of the SPM according to the procedures listed in the Preventive Maintenance chapter. Recalibrate if necessary. 3. Inspect all connections associated with the SPM. 4. Replace the SPM assembly if necessary. 5. Replace the Adv. Processor PCB. 6. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 7. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
261	**PROCESS PROBLEM** DRAW not allowed, press RETURN to continue.	The cycle was interrupted with a full bowl. The MCS+ cannot achieve reseparation.	1. Replace the Adv. Processor PCB. 2. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 3. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.

Table 6-1: Error Messages (Continued)

Error Code	Text Message	Description	Suggested Technical Resolution
262	**DOOR OPEN** THE PROTOCOL CARD DOOR IS OPEN	The Protocol Door is open and should be closed.	1. Close the Protocol Card door. 2. Inspect the mechanics of the door. Measure the integrity of the microswitch. Ohm out the switch. 3. Test the microswitch cable at P1 on the Smart Card PCB. 4. Test the ribbon cable from the Smart Card Assembly to the Adv. Processor PCB. 5. If all ribbon cables test good, complete a power supply test at the test points on the Adv. Personality PCB. If the power supplies pass, go to step 7. 6. If voltages are not present, inspect the main power cord, power entry module fuses, and AC power at the line filter. Test the power supplies at P1 of the Power supply. Refer to the system schematics. If no power is present, test the internal fuse of the power supply. If no problem is found with the fuse, replace the power supply. 7. Replace the Adv. Processor PCB. 8. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 9. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
263	**CENTRIFUGE PROBLEM** THE CENTRIFUGE COVER IS NOW LOCKED		
264	**DOOR CLOSED** THE PROTOCOL CARD DOOR IS CLOSED	The Protocol door is closed.	
265	**SYSTEM PROBLEM** PUMP MANIFOLD NOT INSTALLED	The White Pump manifold is not snapped in place.	1. Snap the manifold in place. 2. Check the installation of the pump tubing. 3. Inspect and clean the disposable ID reader window. 4. Using Utilities, under Diagnostics, complete the diagnostic tests for the disposable ID reader. 5. If failure, replace the disposable ID PCB. 6. Replace the Adv. Safety PCB.
305	**STOP KEY PRESSED**	The MCS+ detects that the STOP key has been pressed.	

Table 6-1: Error Messages (Continued)

Error Code	Text Message	Description	Suggested Technical Resolution
331	**AIR DETECTED BY** THE BLOOD LINE AIR DETECTOR (BLAD)	The BLAD detects air.	1. Use the Air Detector test in Diagnostics to verify the problem. 2. Refer to system schematics and check, repair, or replace all electrical connections associated with the failed air detector. 3. Replace the Adv. Processor PCB. 4. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 5. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
340	**AIR REMOVED** AIR REMOVED FROM THE AIR DETECTOR	The air detector detects fluid.	1. Use the Air Detector test in Diagnostics to verify the problem. 2. Refer to system schematics and check, repair, or replace all electrical connections associated with the failed air detector. 3. Replace the Adv. Processor PCB. 4. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 5. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
341	**NO FLOW** NO FLOW FROM THE DONOR IS DETECTED	Pump speeds have decelerated to zero because of low pressure measurement by the DPM.	1. This is a normal message if pressure from the donor is low, possibly caused by a flow restriction. 2. Use Diagnostics to check the DPM calibration. 3. Replace the DPM assembly. Use Utilities to calibrate the DPM and SPM in the A/D screen, and safety system for DPM only.
343	**SYSTEM PROBLEM** NO PRESSURE CHANGE DETECTED AT DPM	The DPM cannot detect venous pressure change.	1. Check the donor tubing for occlusions and clamps. 2. Ensure the DPM filter is dry. 3. Use Diagnostics to check the DPM calibration. 4. Replace the DPM assembly. Use Utilities to calibrate the DPM and SPM in the A/D screen, and safety system for DPM only.

Table 6-1: Error Messages (Continued)

Error Code	Text Message	Description	Suggested Technical Resolution
344	**SYSTEM PROBLEM** NO PRESSURE CHANGE DETECTED AT THE SPM	No pressure change was detected at the SPM.	1. Check the SPM tubing for occlusion and clamps. 2. Ensure the SPM filter is dry. 3. Using Utilities, check the calibration of the SPM and recalibrate if necessary according to the procedures in the Preventive Maintenance chapter. 4. Replace the SPM PCB or SPM assembly. **Note: The product shelf life becomes 24 hr. if the SPM filter is wet.**
345	**PRESSURE PROBLEM** THE DPM PRESSURE IS OUT OF RANGE	The DPM pressure is out of range.	1. Close the needle clamp. 2. Open the Red valve and turn the Blood pump CLOCKWISE. 3. Using Utilities, check the calibration of the DPM and recalibrate if necessary according to the procedures in the Preventive Maintenance chapter. 4. Using Utilities, check the safety system values. 5. Replace the DPM PCB or DPM assembly.
351	**NO FLOW** PRIME FLOW CONTROL PROBLEM	The MCS+ detected no flow caused by high pressure or vacuum at the DPM.	1. Close the needle clamp. 2. Open the Red valve and turn the Blood pump CLOCKWISE. 3. Using Utilities, check the calibration of the DPM and recalibrate if necessary according to the procedures in the Preventive Maintenance chapter. 4. Using Utilities, check the safety system values. 5. Replace the DPM PCB or DPM assembly.
370	**INTERLOCK FAILURE**	The MCS+ detects an interlock failure, SPM/DPM.	1. Refer to the system schematic and check, repair, or replace all electrical connections associated with the DPM and SPM. 2. Use Diagnostics to check DPM and SPM interlocks. Check that filter sleeve is properly installed in DPM and SPM. Replace DPM and SPM if problem found. 3. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, Safety System, and Serial #. 4. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values. 5. Replace the Adv. Motor Driver PCB.

Table 6-1: Error Messages (Continued)

Error Code	Text Message	Description	Suggested Technical Resolution
372	**CARD/DISPOSABLE MISMATCH**	The MCS+ detects that the card does not match the disposable.	1. Verify the card and disposable match. 2. Test the disposable ID sensor in diagnostic. 3. Check the cable for the PCB to top deck. 4. Replace the disposable ID PCB.
373	**PRESSURE PROBLEM** NO DONOR PRESSURE CHANGE DETECTED AT THE DPM	No donor pressure change detected at the DPM.	1. Check the DPM tubing for occlusion and clamps. 2. Ensure the DPM filter is dry. 3. Using Utilities, check the calibration of the DPM and recalibrate if necessary according to the procedures in the Preventive Maintenance chapter. 4. Replace the DPM PCB or DPM assembly. **Note: The product shelf life becomes 24 hr. if the DPM filter is wet.**
374	**PRESSURE PROBLEM** NO SYSTEM PRESSURE CHANGE DETECTED AT THE SPM	No system pressure change detected at the SPM.	1. Check the SPM tubing for occlusion and clamps. 2. Ensure the SPM filter is dry. 3. Using Utilities, check the calibration of the SPM and recalibrate if necessary according to the procedures in the Preventive Maintenance chapter. 4. Replace the SPM PCB or SPM assembly. **Note: The product shelf life becomes 24 hr. if the SPM filter is wet.**
379	**WEIGHER PROBLEM** EXPECTED FLUID FLOW TO WEIGHER NOT DETECTED	No change in bag weight was detected.	1. Using Utilities, check the OFFSET and calibration value of the weigher. Recalibrate if necessary according to the procedures in the Preventive Maintenance chapter. 2. If the OFFSET is greater than 200, replace the load cell assembly. 3. Replace the Adv. Processor PCB. 4. 4Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 5. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.

Table 6-1: Error Messages (Continued)

Error Code	Text Message	Description	Suggested Technical Resolution
380	**WEIGHER PROBLEM** EXPECTED FLUID FLOW FROM WEIGHER NOT DETECTED	No change in bag weight was detected.	1. Using Utilities, check the OFFSET and calibration value of the weigher. Recalibrate if necessary according to the procedures in the Preventive Maintenance chapter. 2. If the OFFSET is greater than 200, replace the load cell assembly. 3. Replace the Adv. Processor PCB. 4. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 5. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
386	**WEIGHER PROBLEM** THE WEIGHT OF THE BAGS ON THE WEIGHER CHANGED	For TPE, the weigher detects a large weight change.	1. Using Utilities, check the OFFSET and calibration value of the weigher. Recalibrate if necessary according to the procedures in the Preventive Maintenance chapter. 2. If the OFFSET is greater than 200, replace the load cell assembly. 3. Replace the Adv. Processor PCB. 4. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 5. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
387	**WEIGHER PROBLEM** THE WEIGHT OF THE BAGS ON THE WEIGHER CHANGED	An unexpected weight change occurred. **Do not touch the Weigher during operation.**	1. Using Utilities, check the OFFSET and calibration value of the weigher. Recalibrate if necessary according to the procedures in the Preventive Maintenance chapter. 2. If the OFFSET is greater than 200, replace the load cell assembly. 3. Replace the Adv. Processor PCB. 4. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 5. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
388	**PROCEDURE RECOVERY** The POWER has been OFF for a short time.	A recovery sequence can be performed to continue the last procedure, or a new procedure may be initiated.	

Table 6-1: Error Messages (Continued)

Error Code	Text Message	Description	Suggested Technical Resolution
389	**PROCESS PROBLEM** RETURN CYCLE NOT COMPLETED	The Return Cycle was not completed; the bowl is not empty. The BLAD air signal indicates air before 200 ml plus plasma return volume has been pumped from the bowl.	1. This condition could be the result of the bowl not completely emptying. This may occur if the RBCs in the bowl are very viscous, caused by excessive centrifugation. 2. Use the air detector test in Diagnostics to confirm that the BLAD has malfunctioned. 3. Refer to the system schematic and check, repair, or replace all electrical connections associated with the BLAD air detector. 4. With fluid-filled tubing installed in the air detector, measure +5 VDC fluid, and 0 VDC air BLAD signal at P605, pin 4 on the Top Deck Dist. PCB. If no signal, replace the ACAD. 5. Replace the Adv. Processor PCB. 6. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 7. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
390	**PROCESS PROBLEM** Incomplete cycle. No product collected.	No platelets were collected during this cycle. The cycle was interrupted early.	
391	**PROCESS PROBLEM** Incomplete cycle. No product collected.	For TPE, the waste bag is full. Replace.	1. Using Utilities, check the OFFSET and calibration value of the weigher. Recalibrate if necessary according to the procedures in the Preventive Maintenance chapter. 2. If the OFFSET is greater than 200, replace the load cell assembly. 3. Replace the Adv. Processor PCB. 4. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 5. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
393	**ECV MAX** THE DONOR ECV LIMIT IS REACHED	The maximum allowable Extra Corporeal Volume (ECV) limit was reached. **A complete Return Cycle must be performed.**	1. This message could occur if the hematocrit of the donor's blood is very low, or if the blood efficiency is negatively affected by a flow restriction, or a problem pertaining to the pump rotor. 2. Conduct a flow test on the blood pump. Replace the blood pump rotor if efficiency is less than ±10% of set volume.

Table 6-1: Error Messages (Continued)

Error Code	Text Message	Description	Suggested Technical Resolution
394	**ECV LIMIT** xx% TBV Reached – Return Now?	The Extra Corporeal Volume (ECV) limit was reached. Decide whether to continue to Draw, or to start the Return Cycle.	1. This message could occur if the hematocrit of the donor's blood is very low, or if the blood efficiency is negatively affected by a flow restriction, or a problem pertaining to the pump rotor. 2. Conduct a flow test on the blood pump. Replace the blood pump rotor if efficiency is less than ±10% of set volume.

Table 6-1: Error Messages (Continued)

Error Code	Text Message	Description	Suggested Technical Resolution
395	**SYSTEM PROBLEM** THE PRODUCT BAG IS CLAMPED	The effluent tubing may not be installed.	1. Check the tubing at the Yellow, White, and Green valves. 2. Check the slide clamp at the SPM. 3. Use the valve test in Diagnostics to manually transition the valves and monitor the valve switch and response. The valve position is normally closed (approx. 0 volts), and when open, -5 VDC can be measured on the black wire terminal. Power to the pinch valve should be +5 volts on the brown wire. 4. Swap valve connections at the Top Deck Dist. PCB to isolate the problem to the valve circuit. Replace the valve if necessary. 5. If the valve does not move, refer to the system schematic and check, repair, or replace all connections associated with the valve circuit. 6. Replace the Adv. Valve Driver PCB, or Adv. Processor PCB. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 7. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values. 8. Check all pneumatic and electrical connections on valve compressor. 9. Install the Bio-Tek Pressure Meter in line with the compressor to measure the psi. It should maintain a pressure of 20-25 psi. 10. Test for +15 volts at Pin 4 (red wire) of P614 on the Top Deck Dist. PCB. (Use SYSGND on the Adv. Personality PCB.) Reference system schematic sheet 6 of 6 and Drawing 37187-00 (Top Deck Dist. PCB). 11. If voltage is present, check Pin 1 (black wire) of P614 on the Top Deck Dist. PCB for 28 volts. 12. If voltages are present at P614, test the pneumatics module for voltages and inspect the cable for connection issues. 13. If the cable has no problems and the voltages are present, replace the pneumatics module.

Table 6-1: Error Messages (Continued)

Error Code	Text Message	Description	Suggested Technical Resolution
396	**SYSTEM PROBLEM** THE PRODUCT BAG IS CLAMPED	The tubing to the product bag is clamped.	1. Check the tubing at the Green Valves. 2. Check the tubing for closed clamps and kinks. 3. Use the valve test in Diagnostics to manually transition the valves and monitor the valve switch and response. The valve position is normally closed (approx. 0 volts), and when open, -5 VDC can be measured on the black wire terminal. Power to the pinch valve should be +5 volts on the brown wire. 4. Swap valve connections at the Top Deck Dist. PCB to isolate the problem to the valve circuit. Replace the valve if necessary. 5. If the valve does not move, refer to the system schematic and check, repair, or replace all connections associated with the valve circuit. 6. Replace the Adv. Valve Driver PCB, or Adv. Processor PCB. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 7. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values. 8. Check all pneumatic and electrical connections on valve compressor. 9. Install the Bio-Tek Pressure Meter in line with the compressor to measure the psi. It should maintain a pressure of 20-25 psi. 10. Test for +15 volts at Pin 4 (red wire) of P614 on the Top Deck Dist. PCB. (Use SYSGND on the Adv. Personality PCB.) Reference system schematic sheet 6 of 6 and Drawing 37187-00 (Top Deck Dist. PCB). 11. If voltage is present, check Pin 1 (black wire) of P614 on the Top Deck Dist. PCB for 28 volts. 12. If voltages are present at P614, test the pneumatics module for voltages and inspect the cable for connection issues. 13. If the cable has no problems and the voltages are present, replace the pneumatics module.

Table 6-1: Error Messages (Continued)

Error Code	Text Message	Description	Suggested Technical Resolution
397	**BOWL TYPE MISMATCH**	A different bowl size was detected. Decide whether the MCS+ detected the correct bowl.	1. Using Utilities, check the operation of the optics under Diagnostics. 2. Ensure the optics lens is clean. 3. Replace the optics block or banner unit. 4. Replace the CPU.
398	**PROCESS PROBLEM** IS THE BUFFY BAG EMPTY?	Air has been detected at the BLAD, indicating that the buffy bag may be empty.	1. Press the YES key to confirm and switch to donor **or** 2. Press the NO key to continue the Draw Cycle from the buffy bag.
399	**PROCESS PROBLEM** IF THE BUFFY BAG EMPTY?	No air has been detected at the BLAD but the buffy bag should be empty.	1. =Press the YES key to confirm and switch to donor **or** 2. Press the NO key to continue to draw from the buffy bag.
400	**SELF TEST PROBLEM** THE COMPUTER CPU TEST FAILED	The CPU self-test has failed.	1. Replace the Adv. Processor PCB. 2. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 3. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
402	**SELF TEST PROBLEM** THE COMPUTER BIOS CRC TEST FAILED	The BIOS CRC self-test has failed.	1. Accept new BIOS CRC in calibration. 2. Calibrate A/D, centrifuge. 3. Replace the Adv. Processor PCB. 4. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 5. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
403	**SELF TEST PROBLEM** THE PROTOCOL CRC TEST FAILED	The Protocol CRC self-test has failed.	1. Install a new Protocol Card. 2. Replace the CPU PCB.
404	**SELF TEST PROBLEM** THE CARD CRC TEST FAILED	The Card CRC self-test has failed.	1. Replace the Protocol Card. 2. Replace the Adv. Processor PCB. 3. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 4. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.

Table 6-1: Error Messages (Continued)

Error Code	Text Message	Description	Suggested Technical Resolution
405	**SELF TEST PROBLEM** THE CALIBRATION CRC TEST FAILED	The Calibration CRC self-test has failed.	1. Recalibrate the A/D and centrifuge. 2. Replace the Adv. Processor PCB. 3. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 4. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
406	**SELF TEST PROBLEM** THE CONFIGURATION CRC TEST FAILED	The Configuration CRC self-test has failed.	1. Replace the Adv. Processor PCB. 2. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 3. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
407	**NOTICE** THE PROTOCOL CARD DOES NOT MATCH DISPOSABLE	The installed Protocol Card and disposable do not match.	1. Check that the correct disposable is installed. 2. Check that the correct Protocol Card is inserted. 3. Ensure the disposable ID reader window is clean. 4. Replace the Protocol Card. 5. Using Utilities, check the operation of the Disposable ID reader under Diagnostics. 6. Replace the Disposable ID PCB. 7. Replace the Adv. Safety PCB.
408	**SELF TEST PROBLEM** ANTICOAGULANT AIR DETECTOR (ACAD) TEST FAILED	The ACAD self-test has failed.	1. Use the Air Detector test in Diagnostics to verify the problem. 2. Refer to system schematics and check, repair, or replace all electrical connections associated with the failed air detector. 3. Replace the Adv. Processor PCB. 4. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 5. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
409	**SELF TEST PROBLEM** BLOOD LINE AIR DETECTOR (BLAD) TEST FAILED.	The BLAD self-test has failed.	1. Use the Air Detector test in Diagnostics to verify the problem. 2. Refer to system schematics and check, repair, or replace all electrical connections associated with the failed air detector. 3. Replace the Adv. Processor PCB. 4. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 5. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.

Table 6-1: Error Messages (Continued)

Error Code	Text Message	Description	Suggested Technical Resolution
410	**SELF TEST PROBLEM** DONOR LINE AIR DETECTOR 1 (DLAD1) TEST FAILED	The DLAD1 self-test has failed.	1. Use the Air Detector test in Diagnostics to verify the problem. 2. Refer to system schematics and check, repair, or replace all electrical connections associated with the failed air detector. 3. Replace the Adv. Processor PCB. 4. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 5. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
411	**SELF TEST PROBLEM** DONOR LINE AIR DETECTOR 2 (DLAD2) TEST FAILED	The DLAD2 self-test has failed.	1. Use the Air Detector test in Diagnostics to verify the problem. 2. Refer to system schematics and check, repair, or replace all electrical connections associated with the failed air detector. 3. Replace the Adv. Processor PCB. 4. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 5. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.

Table 6-1: Error Messages (Continued)

Error Code	Text Message	Description	Suggested Technical Resolution
413	**VALVE PROBLEM** PURPLE VALVE SELF TEST FAILED	The Purple Valve self-test has failed.	1. Use the valve test in Diagnostics to manually transition the valves and monitor the valve switch and response. The valve position is normally closed (approx. 0 volts), and when open, -5 VDC can be measured on the black wire terminal. Power to the pinch valve should be +5 volts on the brown wire. 2. Swap valve connections at the Top Deck Dist. PCB to isolate the problem to the valve circuit. Replace the valve if necessary. 3. If the valve does not move, refer to the system schematic and check, repair, or replace all connections associated with the valve circuit. 4. Replace the Adv. Valve Driver PCB, or Adv. Processor PCB. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 5. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values. 6. Check all pneumatic and electrical connections on valve compressor. 7. Install the Bio-Tek Pressure Meter in line with the compressor to measure the psi. It should maintain a pressure of 20-25 psi. 8. Test for +15 volts at Pin 4 (red wire) of P614 on the Top Deck Dist. PCB. (Use SYSGND on the Adv. Personality PCB.) Reference system schematic sheet 6 of 6 and Drawing 37187-00 (Top Deck Dist. PCB). 9. If voltage is present, check Pin 1 (black wire) of P614 on the Top Deck Dist. PCB for 28 volts. 10. If voltages are present at P614, test the pneumatics module for voltages and inspect the cable for connection issues. 11. If the cable has no problems and the voltages are present, replace the pneumatics module.
414	**VALVE PROBLEM** ORANGE VALVE SELF TEST FAILED	The Orange Valve self-test has failed.	
415	**VALVE PROBLEM** RED VALVE SELF TEST FAILED	The Red Valve self-test has failed.	
416	**VALVE PROBLEM** BLUE VALVE SELF TEST FAILED	The Blue Valve self-test has failed.	
417	**VALVE PROBLEM** YELLOW VALVE SELF TEST FAILED	The Yellow Valve self-test has failed.	
418	**VALVE PROBLEM** WHITE VALVE SELF TEST FAILED	The White Valve self-test has failed.	
419	**VALVE PROBLEM** GREEN VALVE SELF TEST FAILED	The Green Valve self-test has failed.	

Table 6-1: Error Messages (Continued)

Error Code	Text Message	Description	Suggested Technical Resolution
420	**SELF TEST PROBLEM** A/D CONVERTER 20% TEST FAILED	The A/D Converter 20% self-test has failed.	1. Replace the Adv. Processor PCB. 2. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 3. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
421	**SELF TEST PROBLEM** A/D CONVERTER 50% TEST FAILED	The A/D Converter 50% self-test has failed.	1. Replace the Adv. Processor PCB. 2. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 3. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
422	**SELF TEST PROBLEM** A/D CONVERTER 80% TEST FAILED	The A/D Converter 80% self-test has failed.	1. Replace the Adv. Processor PCB. 2. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 3. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
423	**SELF TEST PROBLEM** PLEASE CLAMP THE DPM LINE AND REMOVE FILTER	During self-tests, the DPM and SPM filters cannot be installed.	1. Refer to the system schematic and check, repair, or replace all electrical connections associated with the DPM and SPM. 2. Use Diagnostics to check DPM and SPM interlocks. Check that filter sleeve is properly installed in DPM and SPM. Replace DPM and SPM if problem found. 3. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, Safety System, and Serial #. 4. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
424	**SELF TEST PROBLEM** PLEASE CLAMP THE SPM LINE AND REMOVE FILTER	During self-tests, the DPM and SPM filters cannot be installed.	1. Ensure that DPM/SPM sleeve is properly installed. 2. Use Diagnostics to check DPM and SPM interlocks. Check that filter sleeve is properly installed in DPM and SPM. Replace DPM and SPM if problem found. 3. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, Safety System, and Serial #. 4. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.

Table 6-1: Error Messages (Continued)

Error Code	Text Message	Description	Suggested Technical Resolution
425	**SELF TEST PROBLEM** Please install the DPM filter.	The DPM filter needs to be installed.	1. Ensure that DPM/SPM sleeve is properly installed. 2. Use Diagnostics to check DPM and SPM interlocks. Check that filter sleeve is properly installed in DPM and SPM. Replace DPM and SPM if problem found. 3. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, Safety System, and Serial #. 4. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
426	**SELF TEST PROBLEM** Please install the SPM filter.	The SPM filter needs to be installed.	1. Ensure that DPM/SPM sleeve is properly installed. 2. Use Diagnostics to check DPM and SPM interlocks. Check that filter sleeve is properly installed in DPM and SPM. Replace DPM and SPM if problem found. 3. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, Safety System, and Serial #. 4. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
427	**SELF TEST PROBLEM** THE DPM CONNECTOR TEST FAILED	The MCS+ could not detect that the DPM was removed.	1. Ensure that DPM/SPM sleeve is properly installed. 2. Use Diagnostics to check DPM and SPM interlocks. Check that filter sleeve is properly installed in DPM and SPM. Replace DPM and SPM if problem found. 3. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, Safety System, and Serial #. 4. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.

Table 6-1: Error Messages (Continued)

Error Code	Text Message	Description	Suggested Technical Resolution
428	**SELF TEST PROBLEM** THE SPM CONNECTOR TEST FAILED	The MCS+ could not detect that the SPM was removed.	1. Ensure that DPM/SPM sleeve is properly installed. 2. Use Diagnostics to check DPM and SPM interlocks. Check that filter sleeve is properly installed in DPM and SPM. Replace DPM and SPM if problem found. 3. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, Safety System, and Serial #. 4. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
429	**SELF TEST PROBLEM** THE DPM IS OUT OF TOLERANCE	The DPM offset (ambient pressure) is outside of the acceptable range (2.32 to 2.68 VDC)	1. Refer to the system schematic and check, repair, or replace all electoral connections associated with the DPM. 2. Using Diagnostics, verify that the SPM offset is within spec. If not, replace the SPM. 3. Replace the Adv. Processor PCB. 4. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, Safety System, and Serial #. 5. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
430	**SELF TEST PROBLEM** THE SPM IS OUT OF TOLERANCE	The SPM offset (ambient pressure) is outside of the acceptable range (2.32 to 2.68 VDC)	1. Refer to the system schematic and check, repair, or replace all electrical connections associated with the SPM. 2. Using Diagnostics, verify that the SPM offset is within spec. If not, replace the SPM. 3. Replace the Adv. Processor PCB. 4. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, Safety System, and Serial #. 5. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.

Table 6-1: Error Messages (Continued)

Error Code	Text Message	Description	Suggested Technical Resolution
431	**SELF TEST PROBLEM** THE WEIGHER IS OUT OF TOLERANCE	The weigher signal is out of the allowed range. Error 466 will occur first and if unresolved after 60 seconds, Error 431 is displayed.	1. Using Utilities, check the OFFSET and calibration value of the weigher. Recalibrate if necessary according to the procedures in the Preventive Maintenance chapter. 2. If the OFFSET is greater than 200, replace the load cell assembly. 3. Replace the Adv. Processor PCB. 4. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 5. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
432	**SELF TEST PROBLEM** THE CUFF IS OUT OF TOLERANCE	The cuff pressure is out of the allowed range.	1. Inspect all electrical and pneumatic connections related to the cuff (refer to the system schematics). 2. Test the cuff operation under Pressure Diagnostics. 3. If cuff is out of calibration, recalibrate according to the Preventive Maintenance chapter on cuff calibration. 4. If compressor is still not operational, replace the cuff compressor assembly.
433	**SELF TEST PROBLEM** THE SAFETY SYSTEM FAILED THE SELF TEST	The safety system self-test has failed.	1. Replace the Adv. Safety PCB. 2. Replace the Adv. Processor PCB. 3. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 4. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
434	**SELF TEST PROBLEM** THE SAFETY SYSTEM FAILED THE SELF TEST	The safety system self-test has failed.	1. Replace the Adv. Motor Driver PCB. 2. Replace the Adv. Processor PCB. 3. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 4. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.

Table 6-1: Error Messages (Continued)

Error Code	Text Message	Description	Suggested Technical Resolution
435	**SELF TEST PROBLEM** THE LINE SENSOR OUTPUT IS TOO LOW	The Line Sensor output is too low.	1. Using Utilities, test the Line Sensor voltage under Diagnostics. Refer to the calibration procedures in the Preventive Maintenance chapter for values. 2. If the values are out of range, recalibrate the Line Sensor. 3. Clean the Line Sensor lens. 4. Replace the Line Sensor assembly. 5. Replace the Adv. Processor PCB. 6. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 7. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
436	**SELF TEST PROBLEM** THE LINE SENSOR OUTPUT IS TOO HIGH	The Line Sensor output is too high.	1. Using Utilities, test the Line Sensor voltage under Diagnostics. Refer to the calibration procedures in the Preventive Maintenance chapter for values. 2. If the values are out of range, recalibrate the Line Sensor. 3. Clean the Line Sensor lens. 4. Replace the Line Sensor assembly. 5. Replace the Adv. Processor PCB. 6. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 7. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
438	**SELF TEST PROBLEM** THE WATCHDOG FAILED THE SELF TEST	The Watchdog self-test has failed.	1. Replace the Adv. Safety PCB. 2. Replace the Adv. Valve Driver PCB. 3. Replace the Adv. Processor PCB. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 4. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
439	**SELF TEST PROBLEM** LOW PRESSURE ERROR AT THE DPM	The DPM signal is out of the allowed range.	1. Close the needle clamp. 2. Open the Red valve and turn the Blood pump CLOCKWISE. 3. Using Utilities, check the calibration of the DPM and recalibrate if necessary according to the procedures in the Preventive Maintenance chapter. 4. Using Utilities, check the safety system values. 5. Replace the DPM PCB or DPM assembly.

Table 6-1: Error Messages (Continued)

Error Code	Text Message	Description	Suggested Technical Resolution
441	**SELF TEST PROBLEM** HIGH PRESSURE ERROR AT THE DPM	The DPM signal is out of the allowed range.	1. Close the needle clamp. 2. Open the Red valve and turn the Blood pump CLOCKWISE. 3. Using Utilities, check the calibration of the DPM and recalibrate if necessary according to the procedures in the Preventive Maintenance chapter. 4. Using Utilities, check the safety system values. 5. Replace the DPM PCB or DPM assembly.
443	**SELF TEST PROBLEM** STATE TEST ON CHANNEL 1 FAILED	The State Test on Channel 1 has failed.	1. Replace the Adv. Motor Driver PCB. 2. Replace the Adv. Processor PCB. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 3. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
444	**SELF TEST PROBLEM** STATE TEST ON CHANNEL 2 FAILED	The State Test on Channel 2 has failed.	1. Replace the Adv. Motor Driver PCB. 2. Replace the Adv. Processor PCB. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 3. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
447	**SELF TEST PROBLEM** STATE TEST ON CHANNEL 1 FAILED	The Time Base Test on Channel 1 has failed.	1. Replace the Adv. Motor Driver PCB. 2. Replace the Adv. Processor PCB. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 3. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
448	**SELF TEST PROBLEM** STATE TEST ON CHANNEL 2 FAILED	The Time Base Test on Channel 2 has failed.	1. Replace the Adv. Motor Driver PCB. 2. Replace the Adv. Processor PCB. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 3. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.

Table 6-1: Error Messages (Continued)

Error Code	Text Message	Description	Suggested Technical Resolution
449	**SELF TEST PROBLEM** THE SAFETY SYSTEM FAILED THE SELF TEST	The Safety System self-test has failed.	1. Replace the Adv. Motor Driver PCB. 2. Replace the Adv. Safety PCB. 3. Replace the Adv. Processor PCB. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 4. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
452	**SELF TEST PROBLEM** THE SAFETY SYSTEM FAILED THE SELF TEST	The Safety System self-test has failed.	1. Replace the Adv. Motor Driver PCB. 2. Replace the Adv. Safety PCB. 3. Replace the Adv. Processor PCB. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 4. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
453	**SELF TEST PROBLEM** THE SAFETY SYSTEM FAILED THE SELF TEST	The Safety System self-test has failed.	1. Replace the Adv. Motor Driver PCB. 2. Replace the Adv. Safety PCB. 3. Replace the Adv. Processor PCB. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 4. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
461	**SELF TEST PROBLEM** THE CENTRIFUGE VACUUM SYSTEM IS OBSTRUCTED	The vacuum switch indicates a blockage between the switch and the centrifuge spindle during the system start-up vacuum test.	1. Inspect the hydrophobic filter in the centrifuge spindle and the in-line filter in the pneumatic tubing for wetness or a blockage. Replace as needed. 2. If no blockage exists between the switch and the centrifuge, refer to the system schematic and check, repair, or replace all electrical connections associated with the vacuum switch. 3. Replace the vacuum switch. 4. Replace the Adv. Processor PCB. 5. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 6. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
462	**SELF TEST PROBLEM** DISPOSABLE ID READER FAILED SELF TEST	The Disposable ID reader has failed the self-test.	1. Using Utilities, check the operation of the Disposable ID reader under Diagnostics. 2. Ensure the disposable ID reader window is clean. 3. Replace the Disposable ID PCB. 4. Replace the Adv. Safety PCB.

Table 6-1: Error Messages (Continued)

Error Code	Text Message	Description	Suggested Technical Resolution
466	**WEIGHER PROBLEM** PLEASE REMOVE ALL WEIGHT FROM WEIGHER	The MCS+ is prompting the operator to remove the detected weight from the weigher. This message occurs when the measured offset is ±125 digital units from the programmed offset.	1. Using Utilities, check the OFFSET and calibration value of the weigher. Recalibrate if necessary according to the procedures in the Preventive Maintenance chapter. 2. If the OFFSET is greater than 200, replace the load cell assembly. 3. Replace the Adv. Processor PCB. 4. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 5. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
467	**SELF TEST PROBLEM** PLEASE DISCONNECT THE CUFF FROM REAR PANEL	The MCS+ measures excessive Cuff Pressure.	1. Disconnect the cuff from the rear panel. 2. Completely deflate the cuff. 3. Reconnect the cuff to the rear panel. 4. Inspect all electrical and pneumatic connections related to the cuff (refer to the system schematics). 5. Test the cuff operation under Pressure Diagnostics. 6. If cuff is out of calibration, recalibrate according to the Preventive Maintenance chapter on cuff calibration. 7. If compressor is still not operational, replace the cuff compressor assembly and recalibrate.
468	**SELF TEST PROBLEM** IS LINE SENSOR CLEAN AND TUBING REMOVED?	The MCS+ is prompting the operator to ensure the line sensor is clean and that the tubing has been removed.	1. Using Utilities, test the Line Sensor voltage under Diagnostics. Refer to the calibration procedures in the Preventive Maintenance chapter for values. 2. If the values are out of range, recalibrate the Line Sensor. 3. Clean the Line Sensor lens. 4. Replace the Line Sensor assembly. 5. Replace the Adv. Processor PCB. 6. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 7. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.

Table 6-1: Error Messages (Continued)

Error Code	Text Message	Description	Suggested Technical Resolution
469	**SELF TEST** Please OPEN the Centrifuge Cover latch.	The Centrifuge Cover Switch must be tested for safe operation.	1. Install a bowl into the centrifuge and check that the centrifuge cover halves are completely closed, and that the bowl header is properly aligned in the centrifuge cover halves. Listen for two distinctive clicks from the microswitches when the cover latch knob secures the cover halves. 2. Close and latch the cover halves and measure +28 VDC on P503, Pin 2 and +15 VDC on Pin 3 of the Adv. Personality PCB. If no signal exists, check the alignment of the centrifuge cover latch microswitches and adjust accordingly. 3. If a signal exists, the CPU is not responding, refer to the system schematics and check, repair, or replace all electrical connections associated with the centrifuge cover switch signals. 4. Replace the Adv. Processor PCB. 5. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 6. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.

Table 6-1: Error Messages (Continued)

Error Code	Text Message	Description	Suggested Technical Resolution
470	**SELF TEST** Please CLOSE the Centrifuge Cover latch.	The Centrifuge Cover Switch must be tested for safe operation.	1. Install a bowl into the centrifuge and check that the centrifuge cover halves are completely closed, and that the bowl header is properly aligned in the centrifuge cover halves. Listen for two distinctive clicks from the microswitches when the cover latch knob secures the cover halves. 2. Close and latch the cover halves and measure +28 VDC on P503, Pin 2 and +15 VDC on Pin 3 of the Adv. Personality PCB. If no signal exists, check the alignment of the centrifuge cover latch microswitches and adjust accordingly. 3. If a signal exists, the CPU is not responding, refer to the system schematics and check, repair, or replace all electrical connections associated with the centrifuge cover switch signals. 4. Replace the Adv. Processor PCB. 5. Using Utilities, calibrate all components under A/D, Optics, Centrifuge, and Serial #. 6. Reset the protocol parameters using the MODIFY PROGRAM key if parameters were different from default values.
471	**NOTICE** THE PROTOCOL PARAMETERS HAVE BEEN RESET	The saved protocol parameters have been reset.	Before starting the next procedure: 1. Reprogram the HaemoCalculator. 2. Reset the protocol parameters using the MODIFY PROGRAM key if necessary.
472	THE BIOS CRC HAS FAILED	The computer detects a failure of the BIOS CRC.	1. Calibrate all A/D and Centrifuge. 2. Accept BIOS CRC. 3. Replace the CPU PCB.
475	SELF TEST PROBLEM	THE CALIBRATION REVISION IS INCOMPATIBLE	Turn power OFF, then ON and try again.
476	SELF TEST PROBLEM	THE CONFIGURATION REVISION IS INCOMPATIBLE	Turn power OFF, then ON and try again.
478	SELF TEST PROBLEM	THE CENTRIFUGE RELAY TEST FAILED	Turn power OFF, then ON and try again. NOTE: If problem persists, call Haemonetics Field Service.

MCS+ Safety System: Hardware Detection

The MCS+ device is designed with a special electronic safety circuit board which will oversee all device functions, including the MCS+ software. The *WATCHDOG* system will completely shut down all device function if a problem is detected at this level, guaranteeing security for the donor. The following information could appear to the operator if this type of situation should occur.

	Notification	Help Message
—	SOFTWARE WATCHDOG INVALID ID	The computer has sensed an invalid Software Watchdog ID code. Please turn the power off and contact Haemonetics Customer Service.
—	SOFTWARE WATCHDOG INVALID ID SEQUENCE	The computer has sensed an incorrect Software Watchdog ID sequence. Please turn the power off and contact Haemonetics Customer Service.
—	SOFTWARE WATCHDOG ID TIMEOUT	The computer has sensed a Software Watchdog ID timeout. Please turn the power off and contact Haemonetics Customer Service.
—	SOFTWARE WATCHDOG NOT ENABLED	The computer has sensed that the Software Watchdog was not enabled. Please turn the power off and contact Haemonetics Customer Service.

APPENDIX A
MCS+ Parts List

This appendix is a reference for identifying repair parts available for the MCS+. Many parts are identified by call-outs from illustrations.

International:
For technical assistance or to schedule service please refer to the list of International offices located at the beginning of this manual.

North America:
For technical assistance or to schedule service, call Haemonetics Product Support at (800) 537-2802 or (800) 225-5242.

Language code suffixes

Table 1: Language codes (noted as -LL in the parts list)

Language	***Suffix***	***Language***	***Suffix***
German	-01	Czech	-14
French	-02	Hungarian	-15
Italian	-03	Slovak	-16
Syrillic	-05	Polish	-17
Spanish	-06	Turkish	-18
Portuguese	-07	Korean	-25
Dutch	-08	Chinese (Simplified)	-26
Swedish	-09	Chinese (Traditional)	-27
Danish	-10	Japanese	-28
Finnish	-11	International English	-30
Norwegian	-12	UK English	-40
Greek	-13		

MCS+ Repair Parts List

Miscellaneous Parts	Part Number
Diagnostic Protocol Card (Rev. C.1) International	47536-00
Service Manual	47218-00
8 Valve Machines protocol folder assemblies:	
PPP&FFP	89960-LL
LDP	89961-LL
RBCP+	89963-LL
PBSC	89965-LL
TPE	89967-LL
LDPRBC	89968-LL
SDR&TAE	89969-LL
CSDP	100770-LL
SDP/PLP Protocol Manual/Card Assembly (Rev. D)	LN 09081-00
SDP/PLP Protocol Manual (Rev. G)	39552-00
SDP/PLP Protocol Card (Rev. D)	39971-00
TPE Protocol Manual/Card Assembly	LN 09082-00
TPE Protocol Manual	47022-00
TPE Protocol Card	38813-00
Component Therapy Protocol Manual/Card Assembly	LN 09083-00
Component Therapy Protocol Manual	47131-00
Component Therapy Protocol Card	38817-00
Protocol card holder	47278-00
8 Valve Device Manual Assembly	85230-LL.
General Operators Manual Assembly	39129-00
General Operator's Manual	39551-00
MCS+ Binder	38983-02
MCS+ Binder Label	39895-00
PPP/FFP Pump tubing manifold	52444-00
PPP/FFP Dual pump adapter	85928-02
PPP/FFP single pump adapter	85931-02
Tool Kit	36841-00
Silicone Lubricant	06176-00
Power Cord Assembly	19417-00
230V Power cord	38457-00
Cable Wrap, Velcro	38659-01
Transport Case (LN 9000)	LN 09010-00
Fixture (7 valve machine), Optics	ETE 5007-00
Fixture (8 valve machine), Optics	ETE 5379-00
Cart	07010-00
Cuff Assembly (69 inch)	18101-01
Splice for tubing	18103-00
Cuff Adult	52304-02
Cuff Child	52304-01
Cuff Large	52304-03
Cuff Small (European)	85138-00
Fixture, Optics Alignment	ETD 5379-00
Gray Card	48780-00
Waste Bag	35643-00
Screw (attaches lid to cabinet)	13833-12
Washer	35617-00
Loctite	10422-00

Machine dust cover 49358-00

Weigher Upgrade

Load Cell 38057-00
Tool, Load Cell Alignment .....ETB_5276-02
Weigher Arm 8 Valve Machine 48160-00
Weigher Arm 7 Valve Machine 38397-00

Display Cable Upgrade

Strain Relief Block 47390-02
Display Cable 47631-00
Clamp Strap 47389-02

Top Deck Assembly

Air Sensor (AC) 35159-01
Air Sensor (BLAD) 35159-02
Disposable ID Cable Assembly 38058-00
Disposable ID Reader PCB Assembly 37573-00
Disposable ID, Plastic Lens 37588-00
DPM/SPM Sensor Assembly 37049-00
DPM/SPM Sleeves 34834-00
Line Sensor Assembly with Cover 39436-00
- Line sensor cover 38644-02
- Line sensor cover shaft .....38643-02.
- Gasket, Line Sensor 35381-00
- Calibration Plug 13758-00

Manifold, 8 Valve 49826-00
Pinch Valve Assembly 37136-00
- Valve Gasket 38167-00
- Pinch Valve Labels
  - Blue 10420-01
  - Yellow 10420-02
  - Green 10420-03
  - Red 10420-04
  - White 10420-05
  - Orange 10420-06
  - Purple 10420-08

Pumps
- Rotor Assembly 38671-00
- Self Loading bushing (8 valve machine only) 38536-00
- Roller, Pump Guide (8 valve machine only) 36195-00
- Roller Assembly, Urethan (8 valve machine only) 36649-00
- Dowel Pin, Finish (8 valve machine only) 38683-04
- Dowel Pin, .250 DIA (8 valve machine only) 09264-15
- Roller Guide (8 valve machine only) 37133-00
- Single Pump Assembly 38055-00
- Dual Pump Assembly 38054-00
- Motor Assembly 38056-00
- Rotor Retainer Screw 62311-408
- Pump Labels
  - Red 37759-01

- White 37759-02
- Blue 37759-03
- Pump Gasket 37035-00
- Dual Pump Gasket 38044-00

Tube Guide 35372-00
Top Deck Distribution PCB (w/o Pneumatic Manifold) 37187-00

Final Assembly

Cable, Flex Personality to Deck Dist 38130-00
Cable, CPU to Smart Card 38131-00
Top Distribution Power Cable Assembly 38127-00
Top Distribution Signal Cable Assembly 38128-00
Assembly, Cable, Pressure Switch/Fan Extension 38129-00

Cabinet Sub Assembly

Air Filter — Large 17548-00
Air Filter — Small 18138-00
Cuff Compressor 35450-00
Donor Light PCB Assembly 37561-00
Donor Light Cable Assembly 38107-00
Overlay - Donor Flow (original - using text) 38000-00
Overlay - Donor Flow (new style- using graphics) 48907-00
Drain Tube Assembly 35634-00
Drip Monitor Assembly 38125-00
- Drip Monitor Cable Assembly 38133-00

Bag Pins (side of machine)
- Bag Pin (large) 38391-02
- Bag Pin (small) 35123-02

Photoelectric Assembly 35192-00
Pneumatic Manifold Assembly (Only for vacuum machines) 35363-00
- In-line Air Filter 17400-00
- Vacuum Switch 35620-00
- Valve, Solenoid 35619-00
- Valve, Manual Dump (N.C.) 35629-00

Pneumatics Module PCB Assembly 37383-00
- Compressor 37904-00
- Pneumatic Module Assembly 37390-00
  - Pneumatic PCB Assembly 37199-00

Power Entry Module 35358-00
- Fuse, Fast Acting - 3AG 19296-01
- Fuse Fast Acting 5x20 mm 2.5 Amps 19637-01
- Fuse Holder for 5x20mm Fuse 19642-00
- Filter, Power Entry Line 36277-00

Voltage Marking Label (8 valve machine) 85255-019
Power Supply Assembly - Condor (For replacement of Todd Power supply) 48542-00
- Power Supply - Condor 48102-00
- Spacer 48116-02
- Mounting Bracket, Left 48117-02
- Mounting Bracket, Right 48118-02
- Screw 61621-108
- Screws (10 required) 61621-104

Vacuum Pump 38394-00
Expansion Chamber 37123-00

IV Pole Assembly

IV Pole - Lower, Finish 37731-02
Plug - Lower IV Pole, Finish 37732-02
IV Pole - Upper, Finish 37747-02
Stop retainer screw 61621-106
Stop - Upper IV Pole, Finish 37775-02
Bag Hanger, Short 39978-02
Bag Hanger, Long, Finish 39979-02
Collar, Top, Paint 37726-04
Middle Collar 37760-04
Middle Collar Button 37729-02
Spring 09206-51
Button - Lower (part of final assembly) 37730-02
Top Collar Button 37727-02

Card Cage Assembly

Backplane PCB assembly 50160-01
Advanced Backplane PCB 36728-00
Motor Driver - Field Service Kit 50830-01
Motor Driver PCB 36743-00
Personality PCB 36746-00
Processor PCB (CPU) 50846-01
Safety PCB 36737-00
Valve Driver PCB 36740-00

Front Panel Assembly

"MCS+" Silkscreen 37689-03
Bag Pin 38391-02
Air Sensor (DLAD1) 35159-01
Air Sensor (DLAD2) 35159-02
Filter Holder 17541-02
Platelet Filter Holder 49660-00
Front Panel Mounting Screws 61111-106

Rear Panel Assembly

Cable - CPU to Serial Port 39992-00
Fan Assembly 35830-00
Knob - Cord Wrap 38079-00
Quick Disconnect for Cuff 35279-02
Rear Cover Stop 35157-00
RS-232 Cover 39052-02
Rear panel Mounting Screws 61111-104
Rear Panel Assembly with Data Card 86102-00
Data Card 86198-01
Bar Code Reader 85943-00
Bar Code Reader Holder 50268-00
Caution Serial Number Label (8 valve machine) 85257-LL
WEEE Label 101363-00

Top Cover Assembly

- Donor Light PCB Assembly 37558-00
  - Overlay - Donor Flow (original - using text) 38001-00
  - Overlay - Donor Flow (new style - using graphics) 48908-00
  - Donor Light Cable (22") 38426-00
  - Donor Light 5" Cable Assembly 38427-00
- Membrane Panel Assembly 38108-00
  - Display Control PCB 38578-00
  - Membrane Panel 38355-00
  - Membrane Panel Overlay 85209-LL
  - Panel Weldment Display 37869-03
  - Display Assembly (New) ..... 53051-00 (formerly 37437-00)
  - Display Distribution Cable 38137-00
  - Display Power Cable Assembly 38112-00
- Decorative Panel 37868-03

Centrifuge Assembly, Vacuum 37613-00

- Centrifuge Subassembly (without Optics/Fluid Detector) 37612-00
  - Cap/Cover Assembly 35299-00
    - Cover, Centrifuge, Left Side, Fin 35279-04
    - Cover, Centrifuge, Right Side, Fin 35279-02
    - Cover Switch Assembly 35347-00
  - Centrifuge Knob Replacement Kit 38461-00
  - Centrifuge Mount and Fluid Drain Assembly 35380-00
  - Chuck Adapter Assembly 38170-00
  - Chuck, Centrifuge, Finished 35282-02
  - Chuck/Bowl Vacuum Seal (L Gasket) 39487-00
  - Filler Ring 38501-00
  - Chuck Spacer Assembly 36604-00
  - Drain Tube, Large, Finished 19609-02
  - Filter, Hydrophobic 35615-00
  - Motor Assembly 47897-00
  - O-Ring, Teflon 35613-00
  - Ring, Filler 39501-00
  - Screen, Support 35614-00
  - Seal, Chuck/Bowl (L-Gasket) 39487-00
  - Vibration Isolator, G-402-1 35288-02
- Seal Replacement Kit 37210-00
- Seal Replacement Tool Kit 37211-00
- Fluid Sensor Assembly 35294-00
- Optics Cable Assembly 39390-00
  - Hex Keps Size #4-40 Nut 31720-005
  - Spacer, Optics, Finished 35189-02

Centrifuge Assembly, Mechanical Chuck 51433-00

- Subassembly, Centrifuge (Mechanical Chuck) 39627-00
- Assembly, Mechanical Chuck 47099-00
- Assembly, Fluid Sensor, Upper 38710-00
- Assembly, Fluid Sensor, Lower 38711-00
- Fluid Sensor - Long (Kit) 51412-00

Assembly, Fluid Sensor Long 51410-00
Housing 35275-00
Instructions 51450-00
Optics Cable Assembly.....39390-00
Hex Keps Size #4-40 Nut 31720-005
Spacer, Optics, Finished.....35189-02
Label, Centrifuge, Caution 47423-00
Plug.....47370-00
Blow Molded Bowl Adapter.....48910-00

Smart Card Assembly 38118-00

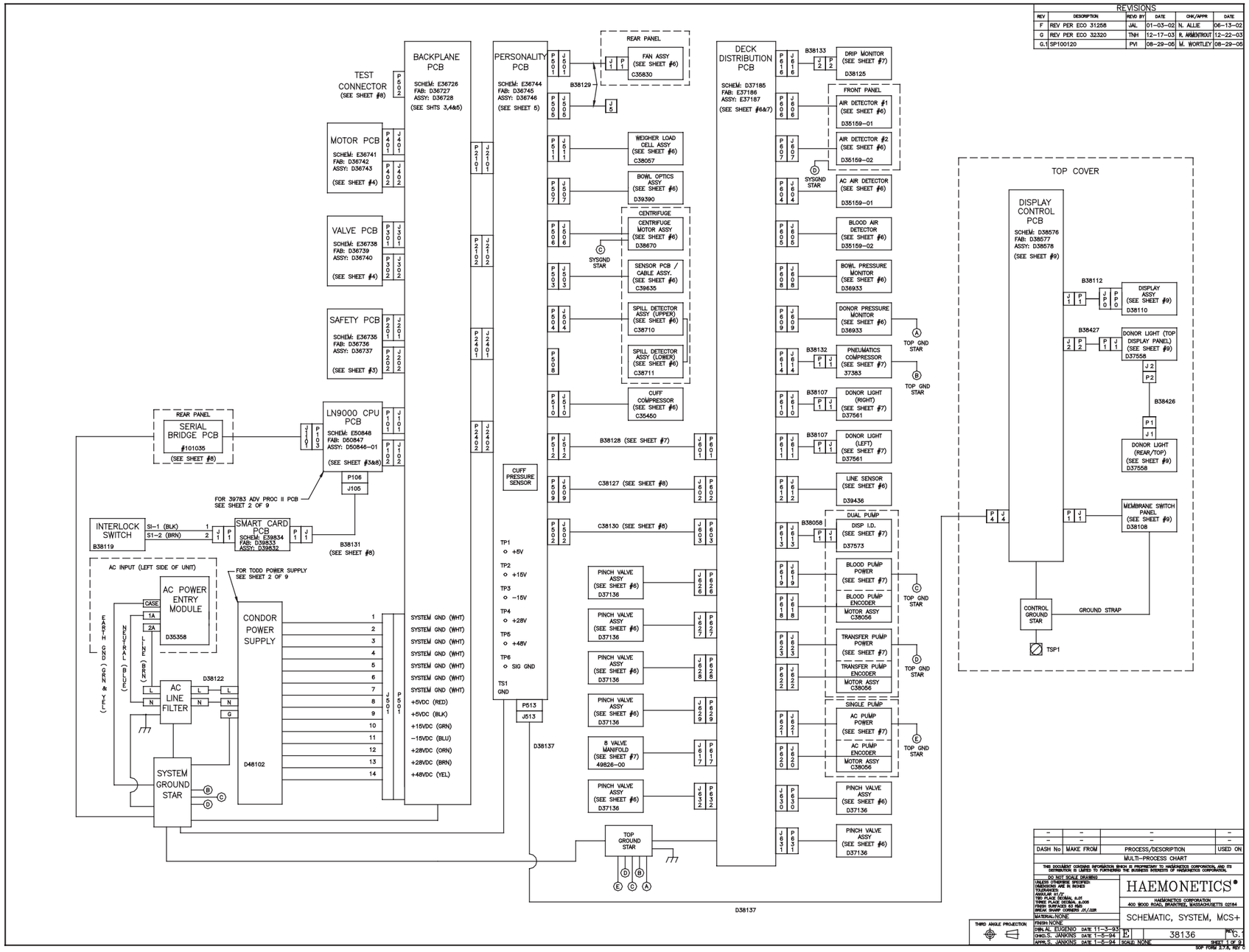
Interlock Switch Assembly 38119-00
Smart Card Interface II 39832-00
Door Seal 37626-00
Switch Cushion.....39164-00

APPENDIX B
MCS+ System Schematics

This section provides detailed schematics for the MCS+. Table B-1 shows the schematic name, part number and number of pages for each schematic in this section.

Table B-1: MCS+ System Schematics

Schematic Name	Part Number	# of pages
MCS+ System Schematics	38136	9
Pneumatics Schematic	38135	1
Top Deck Distribution PCB Assembly	37187	1
Backplane PCB Assembly	50160-01	1
Advanced Personality PCB Assembly	36746	1
Advanced Personality PCB	36744	1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G | REV PER ECO 32320 | TNH | 12-17-03 | R. AMMENTROUT | 12-22-03
G.1 | SP100120 | PVI | 08-29-05 | M. WORTLEY | 08-29-05
BACKPLANE PCB
SCHEM: E36726
FAB: D36727
ASSY: D36728
(SEE SHTS 3,4&5)
PERSONALITY PCB
SCHEM: E36744
FAB: D36745
ASSY: D36746
(SEE SHEET 5)
DECK DISTRIBUTION PCB
SCHEM: D37185
FAB: E37186
ASSY: E37187
(SEE SHEET #6&7)
TEST CONNECTOR
(SEE SHEET #8)
MOTOR PCB
SCHEM: E36741
FAB: D36742
ASSY: D36743
(SEE SHEET #4)
VALVE PCB
SCHEM: E36738
FAB: D36739
ASSY: D36740
(SEE SHEET #4)
SAFETY PCB
SCHEM: E36735
FAB: D36736
ASSY: D36737
(SEE SHEET #3)
LN9000 CPU PCB
SCHEM: E50848
FAB: D50847
ASSY: D50846-01
(SEE SHEET #3&8)
REAR PANEL
SERIAL BRIDGE PCB
#101035
(SEE SHEET #8)
FOR 39783 ADV PROC II PCB SEE SHEET 2 OF 9
INTERLOCK SWITCH
B38119
SMART CARD PCB
SCHEM: E39834
FAB: D39833
ASSY: D39832
B38131 (SEE SHEET #8)
AC INPUT (LEFT SIDE OF UNIT)
AC POWER ENTRY MODULE
D35358
FOR TODD POWER SUPPLY SEE SHEET 2 OF 9
CONDOR POWER SUPPLY
D48102
AC LINE FILTER
D38122
SYSTEM GROUND STAR
REAR PANEL
FAN ASSY (SEE SHEET #6)
C35830
B38129
WEIGHER LOAD CELL ASSY (SEE SHEET #6)
C38057
BOWL OPTICS ASSY (SEE SHEET #6)
D39390
CENTRIFUGE
CENTRIFUGE MOTOR ASSY (SEE SHEET #6)
D38670
SENSOR PCB / CABLE ASSY. (SEE SHEET #6)
C39635
SPILL DETECTOR ASSY (UPPER) (SEE SHEET #6)
C38710
SPILL DETECTOR ASSY (LOWER) (SEE SHEET #6)
C38711
CUFF COMPRESSOR (SEE SHEET #6)
C35450
B38128 (SEE SHEET #7)
C38127 (SEE SHEET #8)
C38130 (SEE SHEET #8)
CUFF PRESSURE SENSOR
TP1 +5V
TP2 +15V
TP3 −15V
TP4 +28V
TP5 +48V
TP6 SIG GND
TS1 GND
P513 / J513
D38137
PINCH VALVE ASSY (SEE SHEET #6) D37136
8 VALVE MANIFOLD (SEE SHEET #7) 49826-00
TOP GROUND STAR
DRIP MONITOR (SEE SHEET #7)
D38125
FRONT PANEL
AIR DETECTOR #1 (SEE SHEET #6)
D35159-01
AIR DETECTOR #2 (SEE SHEET #6)
D35159-02
SYSGND STAR
AC AIR DETECTOR (SEE SHEET #6)
D35159-01
BLOOD AIR DETECTOR (SEE SHEET #6)
D35159-02
BOWL PRESSURE MONITOR (SEE SHEET #6)
D36933
DONOR PRESSURE MONITOR (SEE SHEET #6)
D36933
PNEUMATICS COMPRESSOR (SEE SHEET #7)
37383
TOP GND STAR
DONOR LIGHT (RIGHT) (SEE SHEET #7)
D37561
DONOR LIGHT (LEFT) (SEE SHEET #7)
D37561
LINE SENSOR (SEE SHEET #6)
D39436
DUAL PUMP
DISP I.D. (SEE SHEET #7)
D37573
BLOOD PUMP POWER (SEE SHEET #7)
BLOOD PUMP ENCODER
MOTOR ASSY C38056
TRANSFER PUMP POWER (SEE SHEET #7)
TRANSFER PUMP ENCODER
MOTOR ASSY C38056
SINGLE PUMP
AC PUMP POWER (SEE SHEET #7)
AC PUMP ENCODER
MOTOR ASSY C38056
PINCH VALVE ASSY (SEE SHEET #6) D37136
TOP COVER
DISPLAY CONTROL PCB
SCHEM: D38576
FAB: D38577
ASSY: D38578
(SEE SHEET #9)
B38112
DISPLAY ASSY (SEE SHEET #9)
D38110
B38427
DONOR LIGHT (TOP DISPLAY PANEL) (SEE SHEET #9)
D37558
B38426
DONOR LIGHT (REAR/TOP) (SEE SHEET #9)
D37558
MEMBRANE SWITCH PANEL (SEE SHEET #9)
D38108
CONTROL GROUND STAR
GROUND STRAP
TSP1
DASH No | MAKE FROM | PROCESS/DESCRIPTION | USED ON
MULTI-PROCESS CHART
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TWO PLACE DECIMAL ±.01
THREE PLACE DECIMAL ±.005
FINISH SURFACES 63 RMS
BREAK SHARP CORNERS .01/.02R
MATERIAL: NONE
FINISH: NONE
DRN. AL EUGENIO DATE 11-3-93
CHKD. S. JANKINS DATE 1-5-94
APPR. S. JANKINS DATE 1-5-94
SCALE: NONE
THIRD ANGLE PROJECTION
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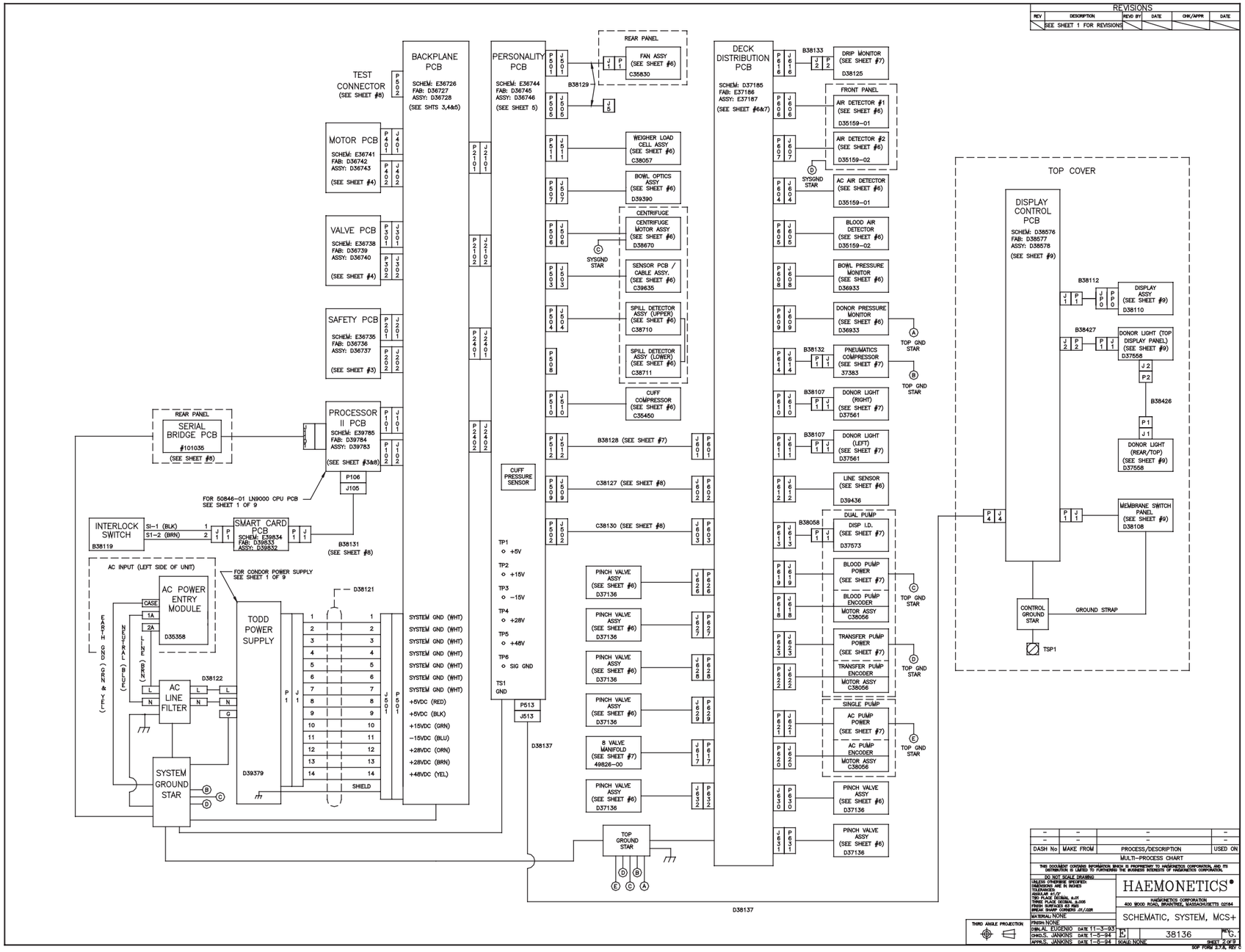
SCHEMATIC, SYSTEM, MCS+
38136
SHEET 1 OF 9
SOP FORM 2.7.A, REV C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REV | DESCRIPTION | REVD BY | DATE | CHK/APPR | DATE
SEE SHEET 1 FOR REVISIONS
BACKPLANE PCB
SCHEM: E36726
FAB: D36727
ASSY: D36728
(SEE SHTS 3,4&5)
PERSONALITY PCB
SCHEM: E36744
FAB: D36745
ASSY: D36746
(SEE SHEET 5)
DECK DISTRIBUTION PCB
SCHEM: D37185
FAB: E37186
ASSY: E37187
(SEE SHEET #6&7)
TEST CONNECTOR
(SEE SHEET #8)
MOTOR PCB
SCHEM: E36741
FAB: D36742
ASSY: D36743
(SEE SHEET #4)
VALVE PCB
SCHEM: E36738
FAB: D36739
ASSY: D36740
(SEE SHEET #4)
SAFETY PCB
SCHEM: E36735
FAB: D36736
ASSY: D36737
(SEE SHEET #3)
PROCESSOR II PCB
SCHEM: E39785
FAB: D39784
ASSY: D39783
(SEE SHEET #3&8)
REAR PANEL
SERIAL BRIDGE PCB
#101035
(SEE SHEET #8)
FOR 50846-01 LN9000 CPU PCB SEE SHEET 1 OF 9
P106
J105
B38131 (SEE SHEET #8)
INTERLOCK SWITCH
B38119
S1-1 (BLK)
S1-2 (BRN)
SMART CARD PCB
SCHEM: E39834
FAB: D39833
ASSY: D39832
AC INPUT (LEFT SIDE OF UNIT)
FOR CONDOR POWER SUPPLY SEE SHEET 1 OF 9
AC POWER ENTRY MODULE
D35358
CASE
1A
2A
EARTH GND (GRN & YEL)
NEUTRAL (BLU)
LINE (BRN)
D38122
AC LINE FILTER
SYSTEM GROUND STAR
D39379
TODD POWER SUPPLY
D38121
SYSTEM GND (WHT)
+5VDC (RED)
+5VDC (BLK)
+15VDC (GRN)
−15VDC (BLU)
+28VDC (ORN)
+28VDC (BRN)
+48VDC (YEL)
SHIELD
TP1 +5V
TP2 +15V
TP3 −15V
TP4 +28V
TP5 +48V
TP6 SIG GND
TS1 GND
P513
J513
D38137
CUFF PRESSURE SENSOR
REAR PANEL
FAN ASSY (SEE SHEET #6)
C35830
B38129
WEIGHER LOAD CELL ASSY (SEE SHEET #6)
C38057
BOWL OPTICS ASSY (SEE SHEET #6)
D39390
CENTRIFUGE
CENTRIFUGE MOTOR ASSY (SEE SHEET #6)
D38670
SYSGND STAR
SENSOR PCB / CABLE ASSY. (SEE SHEET #6)
C39635
SPILL DETECTOR ASSY (UPPER) (SEE SHEET #6)
C38710
SPILL DETECTOR ASSY (LOWER) (SEE SHEET #6)
C38711
CUFF COMPRESSOR (SEE SHEET #6)
C35450
B38128 (SEE SHEET #7)
C38127 (SEE SHEET #8)
C38130 (SEE SHEET #8)
PINCH VALVE ASSY (SEE SHEET #6) D37136
8 VALVE MANIFOLD (SEE SHEET #7) 49826-00
TOP GROUND STAR
B38133
DRIP MONITOR (SEE SHEET #7)
D38125
FRONT PANEL
AIR DETECTOR #1 (SEE SHEET #6)
D35159-01
AIR DETECTOR #2 (SEE SHEET #6)
D35159-02
SYSGND STAR
AC AIR DETECTOR (SEE SHEET #6)
D35159-01
BLOOD AIR DETECTOR (SEE SHEET #6)
D35159-02
BOWL PRESSURE MONITOR (SEE SHEET #6)
D36933
DONOR PRESSURE MONITOR (SEE SHEET #6)
D36933
TOP GND STAR
B38132
PNEUMATICS COMPRESSOR (SEE SHEET #7)
37383
B38107
DONOR LIGHT (RIGHT) (SEE SHEET #7)
D37561
DONOR LIGHT (LEFT) (SEE SHEET #7)
D37561
LINE SENSOR (SEE SHEET #6)
D39436
B38058
DUAL PUMP
DISP LD. (SEE SHEET #7)
D37573
BLOOD PUMP POWER (SEE SHEET #7)
BLOOD PUMP ENCODER
MOTOR ASSY C38056
TRANSFER PUMP POWER (SEE SHEET #7)
TRANSFER PUMP ENCODER
MOTOR ASSY C38056
SINGLE PUMP
AC PUMP POWER (SEE SHEET #7)
AC PUMP ENCODER
MOTOR ASSY C38056
PINCH VALVE ASSY (SEE SHEET #6) D37136
TOP COVER
DISPLAY CONTROL PCB
SCHEM: D38576
FAB: D38577
ASSY: D38578
(SEE SHEET #9)
B38112
DISPLAY ASSY (SEE SHEET #9)
D38110
B38427
DONOR LIGHT (TOP DISPLAY PANEL) (SEE SHEET #9)
D37558
B38426
DONOR LIGHT (REAR/TOP) (SEE SHEET #9)
D37558
MEMBRANE SWITCH PANEL (SEE SHEET #9)
D38108
CONTROL GROUND STAR
GROUND STRAP
TSP1
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TWO PLACE DECIMAL ±.01
THREE PLACE DECIMAL ±.005
FINISH SURFACES 63 RMS
BREAK SHARP CORNERS .01/.02R
MATERIAL: NONE
FINISH: NONE
DWN: AL EUGENIO DATE 11-3-93
CHKD: S. JANKINS DATE 1-5-94
APPR: S. JANKINS DATE 1-5-94
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SCHEMATIC, SYSTEM, MCS+
38136
SCALE: NONE
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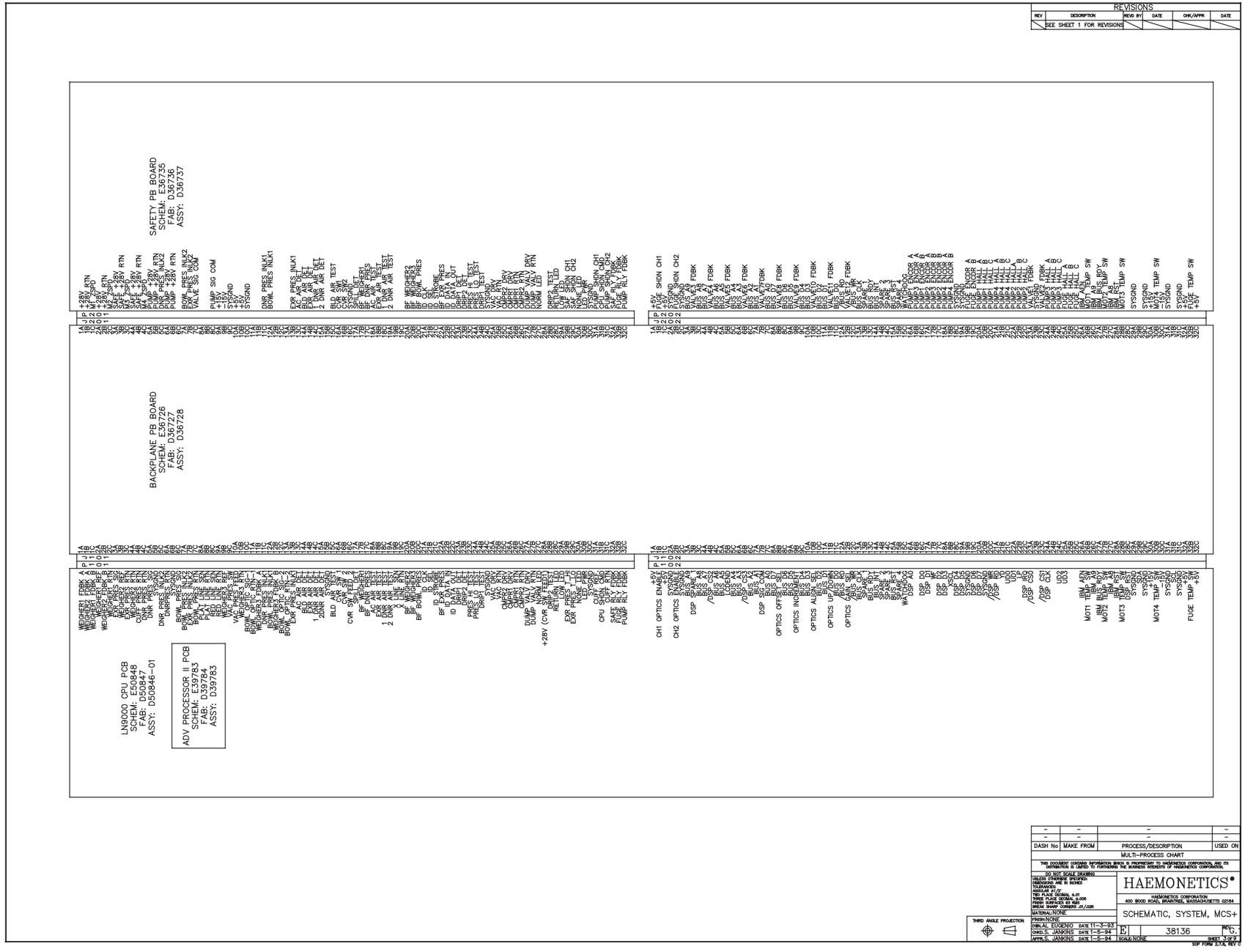
THIRD ANGLE PROJECTION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REV DESCRIPTION MDFD BY DATE CHK/APPR DATE
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SCHEM: E36726
FAB: D36727
ASSY: D36728
SAFETY PB BOARD
SCHEM: E36735
FAB: D36736
ASSY: D36737
LN9000 CPU PCB
SCHEM: E50848
FAB: D50847
ASSY: D50846-01
ADV PROCESSOR II PCB
SCHEM: E39783
FAB: D39784
ASSY: D39783
DASH No MAKE FROM PROCESS/DESCRIPTION USED ON
MULTI-PROCESS CHART
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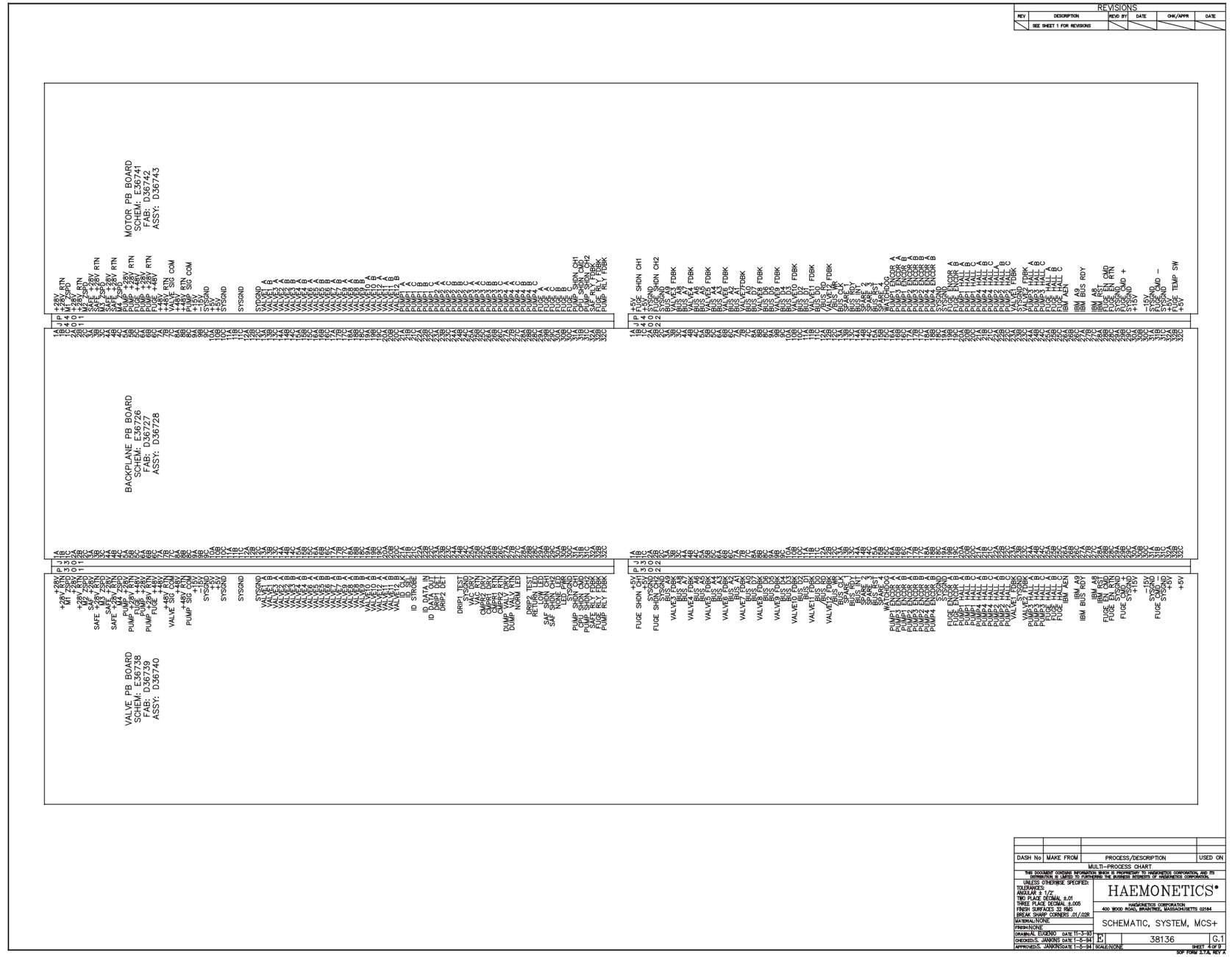
TOLERANCES
ANGULAR ±1/2°
TWO PLACE DECIMAL ±.01
THREE PLACE DECIMAL ±.005
FINISH SURFACES 63 RMS
BREAK SHARP CORNERS .01/.03R
MATERIAL:NONE
FINISH:NONE
DRN:AL EUGENIO DATE:11-3-93
CHKD:S. JANKINS DATE:1-5-94
APPR:S. JANKINS DATE:1-5-94
THIRD ANGLE PROJECTION
HAEMONETICS
HAEMONETICS CORPORATION
400 WOOD ROAD, BRAINTREE, MASSACHUSETTS 02184
SCHEMATIC, SYSTEM, MCS+
38136
SCALE:NONE
SHEET 2 OF 9
SOP FORM 2.7.X REV C


REVISIONS
REV
DESCRIPTION
REVD BY
DATE
CHK/APPR
DATE
SEE SHEET 1 FOR REVISIONS
BACKPLANE PB BOARD
SCHEM: E36726
FAB: D36727
ASSY: D36728
MOTOR PB BOARD
SCHEM: E36741
FAB: D36742
ASSY: D36743
VALVE PB BOARD
SCHEM: E36738
FAB: D36739
ASSY: D36740
DASH No
MAKE FROM
PROCESS/DESCRIPTION
USED ON
MULTI--PROCESS CHART
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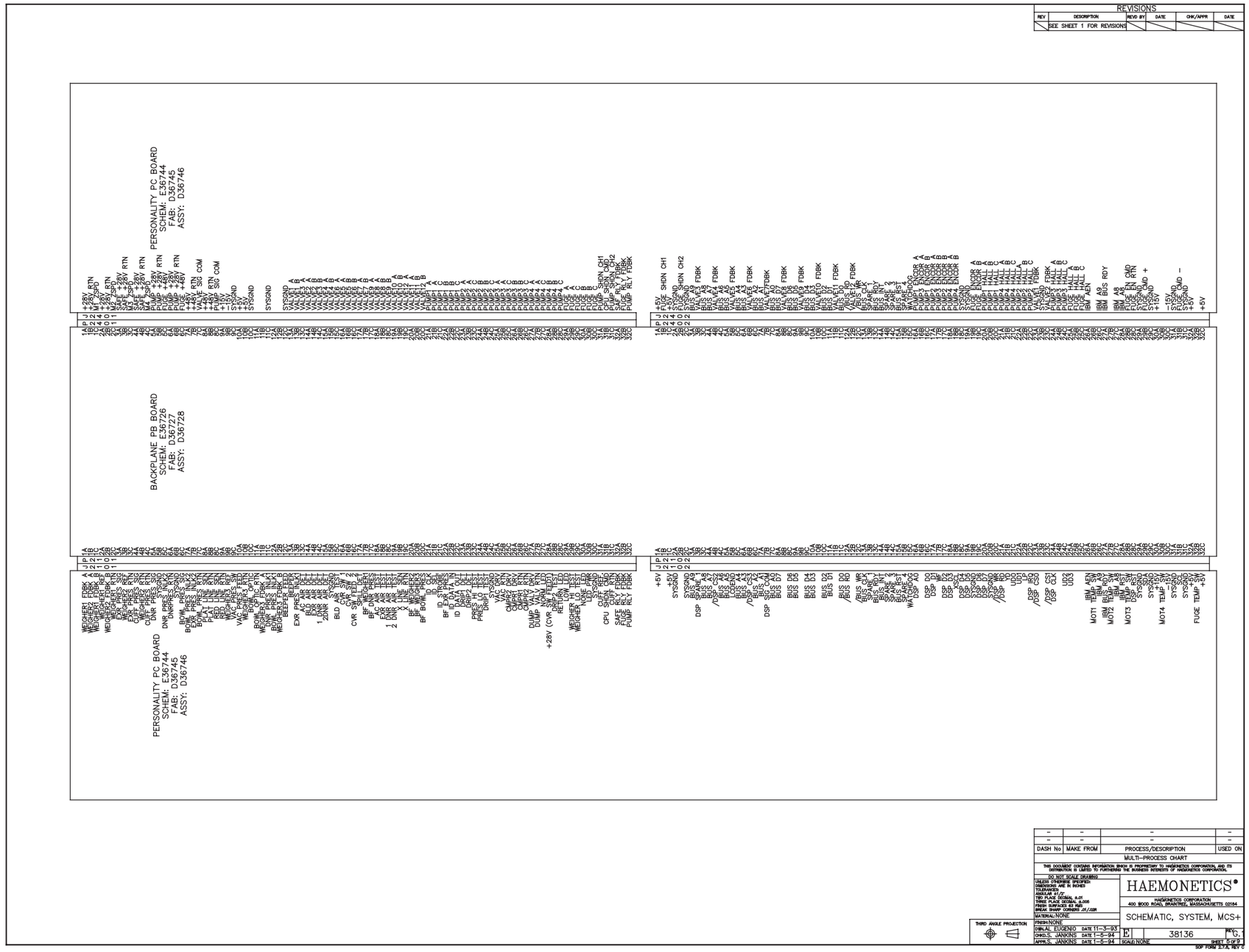
TOLERANCES:
ANGULAR ± 1/2°
TWO PLACE DECIMAL ±.01
THREE PLACE DECIMAL ±.005
FINISH SURFACES 32 RMS
BREAK SHARP CORNERS .01/.025
MATERIAL: NONE
FINISH: NONE
DRAWN: AL TOGNINO DATE: 11-3-93
CHECKED: S. JANKINS DATE: 1-5-94
APPROVED: S. JANKINS DATE: 1-5-94
HAEMONETICS®
HAEMONETICS CORPORATION
400 WOOD ROAD, BRAINTREE, MASSACHUSETTS 02184
SCHEMATIC, SYSTEM, MCS+
SCALE: NONE
38136
G.1
SHEET 4 OF 7
SOP FORM 2.7.A, REV A


REVISIONS
REV DESCRIPTION REVD BY DATE CHK/APPR DATE
SEE SHEET 1 FOR REVISIONS
BACKPLANE PB BOARD
SCHEM: E36726
FAB: D36727
ASST: D36728
PERSONALITY PC BOARD
SCHEM: E36744
FAB: D36745
ASSY: D36746
PERSONALITY PC BOARD
SCHEM: E36744
FAB: D36745
ASSY: D36746
THIRD ANGLE PROJECTION
DASH No MAKE FROM PROCESS/DESCRIPTION USED ON
MULTI-PROCESS CHART
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TOLERANCES:
FRACTIONS ±1/32
TWO PLACE DECIMAL ±.01
THREE PLACE DECIMAL ±.005
FINISH SURFACES 63 RMS
BREAK SHARP CORNERS .01/.02R
MATERIAL: NONE
FINISH: NONE
DRAWN: EUGENIO DATE 11-3-93
CHKD: S. JANKINS DATE 1-5-94
APPR: S. JANKINS DATE 1-5-94
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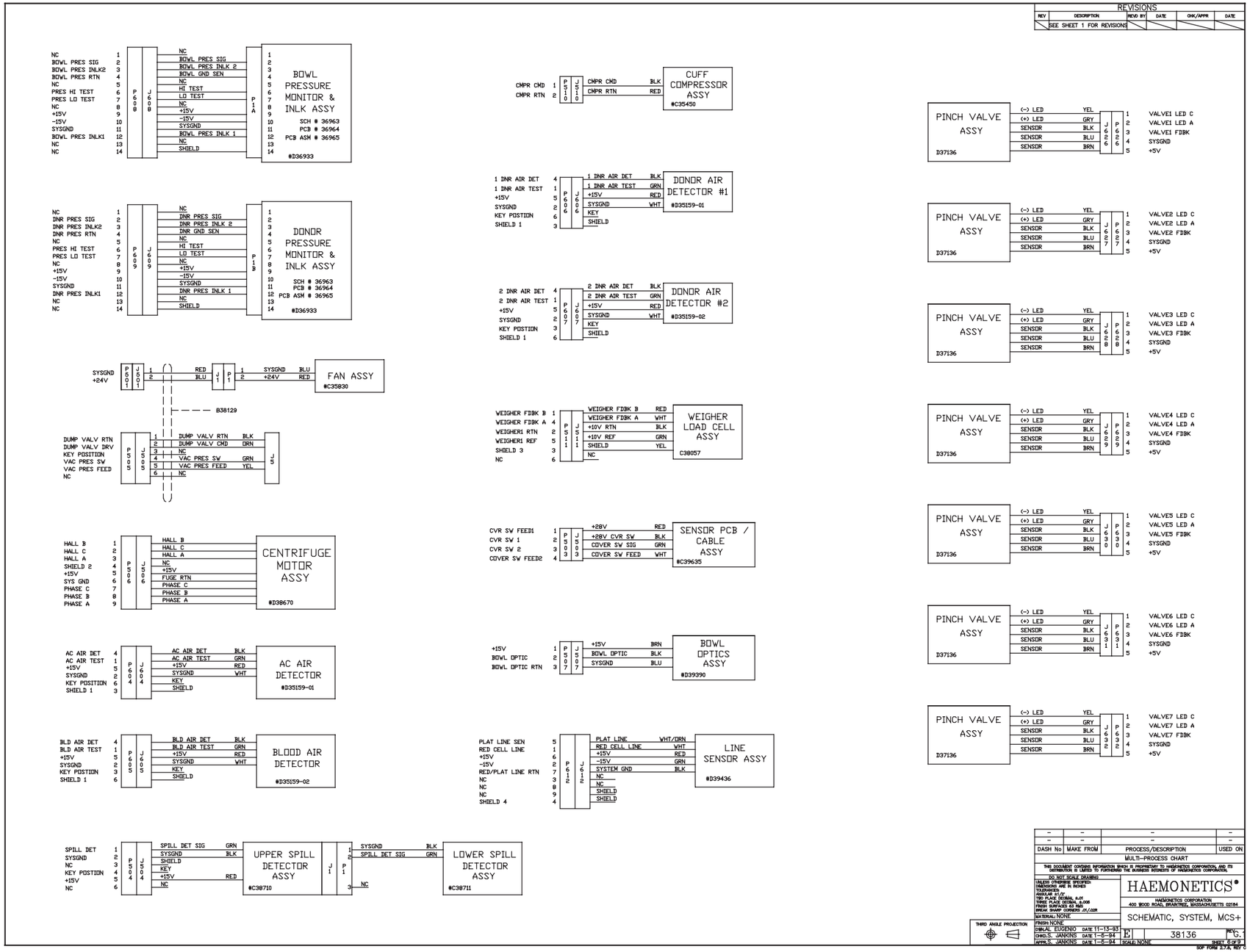
SCHEMATIC, SYSTEM, MCS+
SIZE E
38136
REV G
SCALE: NONE
SHEET 5 OF 9
SOP FORM 37-A, REV C


REVISIONS
REV | DESCRIPTION | REVD BY | DATE | CHK/APPR | DATE
SEE SHEET 1 FOR REVISIONS
NC 1
BOWL PRES SIG 2
BOWL PRES INLK2 3
BOWL PRES RTN 4
NC 5
PRES HI TEST 6
PRES LO TEST 7
NC 8
+15V 9
-15V 10
SYSGND 11
BOWL PRES INLK1 12
NC 13
NC 14
P608 J608
NC
BOWL PRES SIG
BOWL PRES INLK 2
BOWL GND SEN
NC
HI TEST
LO TEST
NC
+15V
-15V
SYSGND
BOWL PRES INLK 1
NC
SHIELD
P1A
BOWL PRESSURE MONITOR & INLK ASSY
SCH # 36963
PCB # 36964
PCB ASM # 36965
#D36933
NC 1
INR PRES SIG 2
INR PRES INLK2 3
INR PRES RTN 4
NC 5
PRES HI TEST 6
PRES LO TEST 7
NC 8
+15V 9
-15V 10
SYSGND 11
INR PRES INLK1 12
NC 13
NC 14
P609 J609
NC
INR PRES SIG
INR PRES INLK 2
INR GND SEN
NC
HI TEST
LO TEST
NC
+15V
-15V
SYSGND
INR PRES INLK 1
NC
SHIELD
P1B
DONOR PRESSURE MONITOR & INLK ASSY
SCH # 36963
PCB # 36964
PCB ASM # 36965
#D36933
SYSGND P501 J501 1 RED
+24V 2 BLU
P1 1 SYSGND BLU
2 +24V RED
FAN ASSY
#C35830
B38129
DUMP VALV RTN 1
DUMP VALV DRV 2
KEY POSITION 3
VAC PRES SW 4
VAC PRES FEED 5
NC 6
P505 J505
DUMP VALV RTN BLK
DUMP VALV CMD ORN
NC
VAC PRES SW GRN
VAC PRES FEED YEL
NC
J1
HALL B 1
HALL C 2
HALL A 3
SHIELD 2 4
+15V 5
SYS GND 6
PHASE C 7
PHASE B 8
PHASE A 9
P506 J506
HALL B
HALL C
HALL A
NC
+15V
FUGE RTN
PHASE C
PHASE B
PHASE A
CENTRIFUGE MOTOR ASSY
#D38670
AC AIR DET 4
AC AIR TEST 1
+15V 5
SYSGND 2
KEY POSITION 6
SHIELD 1 3
P504 J604
AC AIR DET BLK
AC AIR TEST GRN
+15V RED
SYSGND WHT
KEY
SHIELD
AC AIR DETECTOR
#D35159-01
BLD AIR DET 4
BLD AIR TEST 1
+15V 5
SYSGND 2
KEY POSITION 3
SHIELD 1 6
P605 J603
BLD AIR DET BLK
BLD AIR TEST GRN
+15V RED
SYSGND WHT
KEY
SHIELD
BLOOD AIR DETECTOR
#D35159-02
SPILL DET 1
SYSGND 2
NC 3
KEY POSITION 4
+15V 5
NC 6
P504 J504
SPILL DET SIG GRN
SYSGND BLK
SHIELD
KEY
+15V RED
NC
UPPER SPILL DETECTOR ASSY
#C38710
J1 P1
SYSGND BLK
SPILL DET SIG GRN
NC 3
LOWER SPILL DETECTOR ASSY
#C38711
CMPR CMD 1
CMPR RTN 2
P510 J510
CMPR CMD BLK
CMPR RTN RED
CUFF COMPRESSOR ASSY
#C35450
1 INR AIR DET 4
1 INR AIR TEST 1
+15V 5
SYSGND 2
KEY POSITION 6
SHIELD 1 3
P606 J606
1 INR AIR DET BLK
1 INR AIR TEST GRN
+15V RED
SYSGND WHT
KEY
SHIELD
DONOR AIR DETECTOR #1
#D35159-01
2 INR AIR DET 4
2 INR AIR TEST 1
+15V 5
SYSGND 2
KEY POSITION 3
SHIELD 1 6
P607 J607
2 INR AIR DET BLK
2 INR AIR TEST GRN
+15V RED
SYSGND WHT
KEY
SHIELD
DONOR AIR DETECTOR #2
#D35159-02
WEIGHER FDBK B 1
WEIGHER FDBK A 4
WEIGHER1 RTN 2
WEIGHER1 REF 5
SHIELD 3
NC 6
P511 J511
WEIGHER FDBK B RED
WEIGHER FDBK A WHT
+10V RTN BLK
+10V REF GRN
SHIELD YEL
NC
WEIGHER LOAD CELL ASSY
C38057
CVR SW FEED1 1
CVR SW 1 2
CVR SW 2 3
CVR SW FEED2 4
P503 J503
+28V RED
+28V CVR SW BLK
CVR SW SIG GRN
CVR SW FEED WHT
SENSOR PCB / CABLE ASSY
#C39635
+15V 1
BOWL OPTIC 2
BOWL OPTIC RTN 3
P507 J507
+15V BRN
BOWL OPTIC BLK
SYSGND BLU
BOWL OPTICS ASSY
#D39390
PLAT LINE SEN 5
RED CELL LINE 1
+15V 6
-15V 2
RED/PLAT LINE RTN 7
NC 3
NC 8
NC 9
SHIELD 4
P612 J612
PLAT LINE WHT/DRN
RED CELL LINE WHT
+15V RED
-15V GRN
SYSTEM GND BLK
NC
NC
SHIELD
SHIELD
LINE SENSOR ASSY
#D39436
PINCH VALVE ASSY
D37136
(-) LED YEL
(+) LED GRY
SENSOR BLK
SENSOR BLU
SENSOR BRN
J626 P626
1 VALVE1 LED C
2 VALVE1 LED A
3 VALVE1 FDBK
4 SYSGND
5 +5V
PINCH VALVE ASSY
D37136
(-) LED YEL
(+) LED GRY
SENSOR BLK
SENSOR BLU
SENSOR BRN
J627 P627
1 VALVE2 LED C
2 VALVE2 LED A
3 VALVE2 FDBK
4 SYSGND
5 +5V
PINCH VALVE ASSY
D37136
(-) LED YEL
(+) LED GRY
SENSOR BLK
SENSOR BLU
SENSOR BRN
J628 P628
1 VALVE3 LED C
2 VALVE3 LED A
3 VALVE3 FDBK
4 SYSGND
5 +5V
PINCH VALVE ASSY
D37136
(-) LED YEL
(+) LED GRY
SENSOR BLK
SENSOR BLU
SENSOR BRN
J629 P629
1 VALVE4 LED C
2 VALVE4 LED A
3 VALVE4 FDBK
4 SYSGND
5 +5V
PINCH VALVE ASSY
D37136
(-) LED YEL
(+) LED GRY
SENSOR BLK
SENSOR BLU
SENSOR BRN
J630 P630
1 VALVE5 LED C
2 VALVE5 LED A
3 VALVE5 FDBK
4 SYSGND
5 +5V
PINCH VALVE ASSY
D37136
(-) LED YEL
(+) LED GRY
SENSOR BLK
SENSOR BLU
SENSOR BRN
J631 P631
1 VALVE6 LED C
2 VALVE6 LED A
3 VALVE6 FDBK
4 SYSGND
5 +5V
PINCH VALVE ASSY
D37136
(-) LED YEL
(+) LED GRY
SENSOR BLK
SENSOR BLU
SENSOR BRN
J632 P632
1 VALVE7 LED C
2 VALVE7 LED A
3 VALVE7 FDBK
4 SYSGND
5 +5V
DASH No | MAKE FROM | PROCESS/DESCRIPTION | USED ON
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TOLERANCES:
FRACTIONS ±1/32
TWO PLACE DECIMAL ±.05
THREE PLACE DECIMAL ±.005
FINISH SURFACES 63 RMS
BREAK SHARP CORNERS .01/.025
MATERIAL: NONE
FINISH: NONE
DRAWN: A. EUGENIO DATE 11-13-97
CHKD: S. JANKINS DATE 1-5-94
APPR: S. JANKINS DATE 1-5-94
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HAEMONETICS CORPORATION
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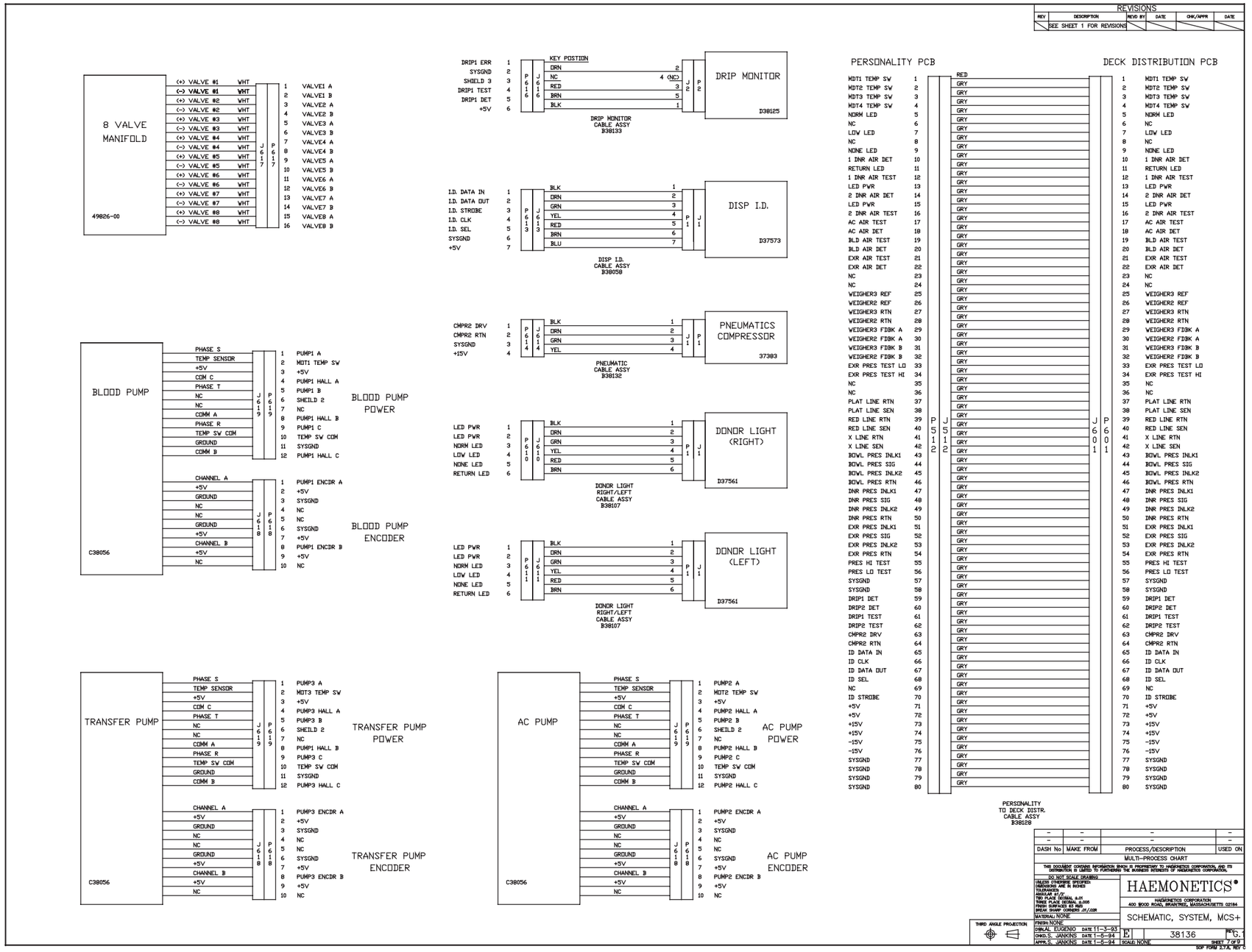
SCHEMATIC, SYSTEM, MCS+
SIZE E
38136
REV G.1
SCALE: NONE
SHEET 6 OF 8
SOP FORM 27A, REV C
THIRD ANGLE PROJECTION


REVISIONS
REV DESCRIPTION MOD BY DATE CHK/APPR DATE
SEE SHEET 1 FOR REVISIONS
8 VALVE MANIFOLD
49826-00
(+) VALVE #1 WHT
(-) VALVE #1 WHT
(+) VALVE #2 WHT
(-) VALVE #2 WHT
(+) VALVE #3 WHT
(-) VALVE #3 WHT
(+) VALVE #4 WHT
(-) VALVE #4 WHT
(+) VALVE #5 WHT
(-) VALVE #5 WHT
(+) VALVE #6 WHT
(-) VALVE #6 WHT
(+) VALVE #7 WHT
(-) VALVE #7 WHT
(+) VALVE #8 WHT
(-) VALVE #8 WHT
J617
P617
1 VALVE1 A
2 VALVE1 B
3 VALVE2 A
4 VALVE2 B
5 VALVE3 A
6 VALVE3 B
7 VALVE4 A
8 VALVE4 B
9 VALVE5 A
10 VALVE5 B
11 VALVE6 A
12 VALVE6 B
13 VALVE7 A
14 VALVE7 B
15 VALVE8 A
16 VALVE8 B
DRIP1 ERR 1
SYSGND 2
SHIELD 3
DRIP1 TEST 4
DRIP1 DET 5
+5V 6
P616
J616
KEY POSTION
DRN 2
NC 4 (NC)
RED 3
BRN 5
BLK 1
J2
P2
DRIP MONITOR
D38125
DRIP MONITOR CABLE ASSY B38133
I.D. DATA IN 1
I.D. DATA OUT 2
I.D. STROBE 3
I.D. CLK 4
I.D. SEL 5
SYSGND 6
+5V 7
P613
J613
BLK 1
DRN 2
GRN 3
YEL 4
RED 5
BRN 6
BLU 7
P1
J1
DISP I.D.
D37573
DISP I.D. CABLE ASSY B38058
CMPR2 DRV 1
CMPR2 RTN 2
SYSGND 3
+15V 4
P614
J614
BLK 1
DRN 2
GRN 3
YEL 4
P1
J1
PNEUMATICS COMPRESSOR
37383
PNEUMATIC CABLE ASSY B38132
LED PWR 1
LED PWR 2
NORM LED 3
LOW LED 4
NONE LED 5
RETURN LED 6
P610
J610
BLK 1
DRN 2
GRN 3
YEL 4
RED 5
BRN 6
P1
J1
DONOR LIGHT (RIGHT)
D37561
DONOR LIGHT RIGHT/LEFT CABLE ASSY B38107
LED PWR 1
LED PWR 2
NORM LED 3
LOW LED 4
NONE LED 5
RETURN LED 6
P611
J611
BLK 1
DRN 2
GRN 3
YEL 4
RED 5
BRN 6
P1
J1
DONOR LIGHT (LEFT)
D37561
DONOR LIGHT RIGHT/LEFT CABLE ASSY B38107
BLOOD PUMP
C38056
PHASE S
TEMP SENSOR
+5V
COM C
PHASE T
NC
NC
COMM A
PHASE R
TEMP SW COM
GROUND
COMM B
J619
P619
1 PUMP1 A
2 MDT1 TEMP SW
3 +5V
4 PUMP1 HALL A
5 PUMP1 B
6 SHEILD 2
7 NC
8 PUMP1 HALL B
9 PUMP1 C
10 TEMP SW COM
11 SYSGND
12 PUMP1 HALL C
BLOOD PUMP POWER
CHANNEL A
+5V
GROUND
NC
NC
GROUND
+5V
CHANNEL B
+5V
NC
J618
P618
1 PUMP1 ENCDR A
2 +5V
3 SYSGND
4 NC
5 NC
6 SYSGND
7 +5V
8 PUMP1 ENCDR B
9 +5V
10 NC
BLOOD PUMP ENCODER
TRANSFER PUMP
C38056
PHASE S
TEMP SENSOR
+5V
COM C
PHASE T
NC
NC
COMM A
PHASE R
TEMP SW COM
GROUND
COMM B
J619
P619
1 PUMP3 A
2 MDT3 TEMP SW
3 +5V
4 PUMP3 HALL A
5 PUMP3 B
6 SHEILD 2
7 NC
8 PUMP1 HALL B
9 PUMP3 C
10 TEMP SW COM
11 SYSGND
12 PUMP3 HALL C
TRANSFER PUMP POWER
CHANNEL A
+5V
GROUND
NC
NC
GROUND
+5V
CHANNEL B
+5V
NC
J618
P618
1 PUMP3 ENCDR A
2 +5V
3 SYSGND
4 NC
5 NC
6 SYSGND
7 +5V
8 PUMP3 ENCDR B
9 +5V
10 NC
TRANSFER PUMP ENCODER
AC PUMP
C38056
PHASE S
TEMP SENSOR
+5V
COM C
PHASE T
NC
NC
COMM A
PHASE R
TEMP SW COM
GROUND
COMM B
J619
P619
1 PUMP2 A
2 MDT2 TEMP SW
3 +5V
4 PUMP2 HALL A
5 PUMP2 B
6 SHEILD 2
7 NC
8 PUMP2 HALL B
9 PUMP2 C
10 TEMP SW COM
11 SYSGND
12 PUMP2 HALL C
AC PUMP POWER
CHANNEL A
+5V
GROUND
NC
NC
GROUND
+5V
CHANNEL B
+5V
NC
J618
P618
1 PUMP2 ENCDR A
2 +5V
3 SYSGND
4 NC
5 NC
6 SYSGND
7 +5V
8 PUMP2 ENCDR B
9 +5V
10 NC
AC PUMP ENCODER
PERSONALITY PCB
MDT1 TEMP SW 1
MDT2 TEMP SW 2
MDT3 TEMP SW 3
MDT4 TEMP SW 4
NORM LED 5
NC 6
LOW LED 7
NC 8
NONE LED 9
1 INR AIR DET 10
RETURN LED 11
1 INR AIR TEST 12
LED PWR 13
2 INR AIR DET 14
LED PWR 15
2 INR AIR TEST 16
AC AIR TEST 17
AC AIR DET 18
BLD AIR TEST 19
BLD AIR DET 20
EXR AIR TEST 21
EXR AIR DET 22
NC 23
NC 24
WEIGHER3 REF 25
WEIGHER2 REF 26
WEIGHER3 RTN 27
WEIGHER2 RTN 28
WEIGHER3 FDBK A 29
WEIGHER2 FDBK A 30
WEIGHER3 FDBK B 31
WEIGHER2 FDBK B 32
EXR PRES TEST LO 33
EXR PRES TEST HI 34
NC 35
NC 36
PLAT LINE RTN 37
PLAT LINE SEN 38
RED LINE RTN 39
RED LINE SEN 40
X LINE RTN 41
X LINE SEN 42
BOWL PRES INLK1 43
BOWL PRES SIG 44
BOWL PRES INLK2 45
BOWL PRES RTN 46
INR PRES INLK1 47
INR PRES SIG 48
INR PRES INLK2 49
INR PRES RTN 50
EXR PRES INLK1 51
EXR PRES SIG 52
EXR PRES INLK2 53
EXR PRES RTN 54
PRES HI TEST 55
PRES LO TEST 56
SYSGND 57
SYSGND 58
DRIP1 DET 59
DRIP2 DET 60
DRIP1 TEST 61
DRIP2 TEST 62
CMPR2 DRV 63
CMPR2 RTN 64
ID DATA IN 65
ID CLK 66
ID DATA OUT 67
ID SEL 68
NC 69
ID STROBE 70
+5V 71
+5V 72
+15V 73
+15V 74
-15V 75
-15V 76
SYSGND 77
SYSGND 78
SYSGND 79
SYSGND 80
P512
J512
RED
GRY
J601
P601
DECK DISTRIBUTION PCB
1 MDT1 TEMP SW
2 MDT2 TEMP SW
3 MDT3 TEMP SW
4 MDT4 TEMP SW
5 NORM LED
6 NC
7 LOW LED
8 NC
9 NONE LED
10 1 INR AIR DET
11 RETURN LED
12 1 INR AIR TEST
13 LED PWR
14 2 INR AIR DET
15 LED PWR
16 2 INR AIR TEST
17 AC AIR TEST
18 AC AIR DET
19 BLD AIR TEST
20 BLD AIR DET
21 EXR AIR TEST
22 EXR AIR DET
23 NC
24 NC
25 WEIGHER3 REF
26 WEIGHER2 REF
27 WEIGHER3 RTN
28 WEIGHER2 RTN
29 WEIGHER3 FDBK A
30 WEIGHER2 FDBK A
31 WEIGHER3 FDBK B
32 WEIGHER2 FDBK B
33 EXR PRES TEST LO
34 EXR PRES TEST HI
35 NC
36 NC
37 PLAT LINE RTN
38 PLAT LINE SEN
39 RED LINE RTN
40 RED LINE SEN
41 X LINE RTN
42 X LINE SEN
43 BOWL PRES INLK1
44 BOWL PRES SIG
45 BOWL PRES INLK2
46 BOWL PRES RTN
47 INR PRES INLK1
48 INR PRES SIG
49 INR PRES INLK2
50 INR PRES RTN
51 EXR PRES INLK1
52 EXR PRES SIG
53 EXR PRES INLK2
54 EXR PRES RTN
55 PRES HI TEST
56 PRES LO TEST
57 SYSGND
58 SYSGND
59 DRIP1 DET
60 DRIP2 DET
61 DRIP1 TEST
62 DRIP2 TEST
63 CMPR2 DRV
64 CMPR2 RTN
65 ID DATA IN
66 ID CLK
67 ID DATA OUT
68 ID SEL
69 NC
70 ID STROBE
71 +5V
72 +5V
73 +15V
74 +15V
75 -15V
76 -15V
77 SYSGND
78 SYSGND
79 SYSGND
80 SYSGND
PERSONALITY TO DECK DISTR. CABLE ASSY B38128
DASH No MAKE FROM PROCESS/DESCRIPTION USED ON
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TOLERANCES
ANGULAR ±1/2°
TWO PLACE DECIMAL ±.01
THREE PLACE DECIMAL ±.005
FRACTIONS AS SHOWN
BREAK SHARP CORNERS .01/.02R
MATERIAL: NONE
FINISH: NONE
DRAWN: EUGENIO DATE: 11-3-93
CHKD: S. JANKINS DATE: 1-6-94
APPR: S. JANKINS DATE: 1-6-94
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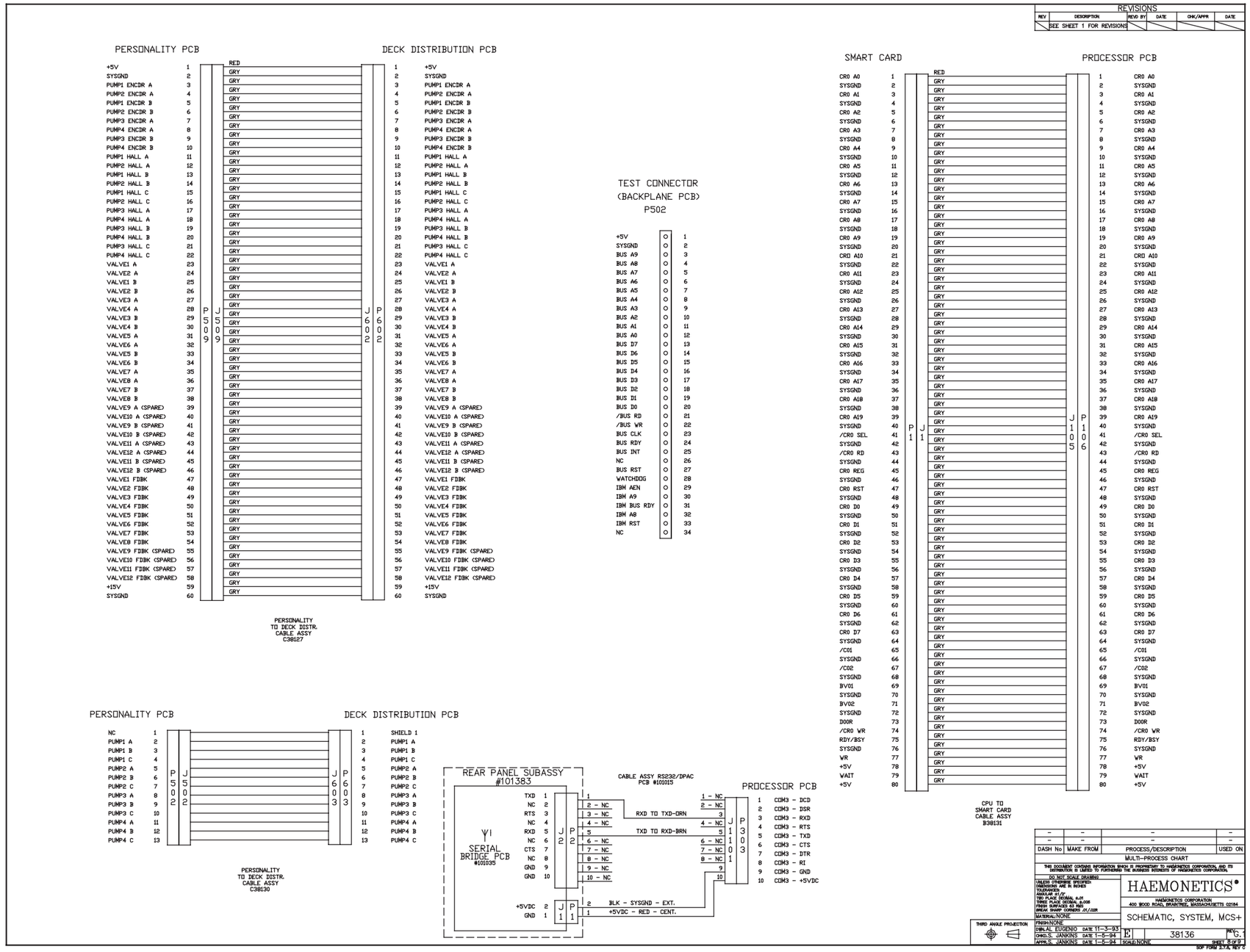
SCHEMATIC, SYSTEM, MCS+
38136
REV: G.1
SCALE: NONE
SHEET 7 OF 9
SOP FORM 2.7.A. REV C
THIRD ANGLE PROJECTION


REVISIONS
REV | DESCRIPTION | REVD BY | DATE | CHK/APPR | DATE
SEE SHEET 1 FOR REVISIONS
PERSONALITY PCB
DECK DISTRIBUTION PCB
+5V 1 | SYSGND 2 | PUMP1 ENCDR A 3 | PUMP2 ENCDR A 4 | PUMP1 ENCDR B 5 | PUMP2 ENCDR B 6 | PUMP3 ENCDR A 7 | PUMP4 ENCDR A 8 | PUMP3 ENCDR B 9 | PUMP4 ENCDR B 10 | PUMP1 HALL A 11 | PUMP2 HALL A 12 | PUMP1 HALL B 13 | PUMP2 HALL B 14 | PUMP1 HALL C 15 | PUMP2 HALL C 16 | PUMP3 HALL A 17 | PUMP4 HALL A 18 | PUMP3 HALL B 19 | PUMP4 HALL B 20 | PUMP3 HALL C 21 | PUMP4 HALL C 22 | VALVE1 A 23 | VALVE2 A 24 | VALVE1 B 25 | VALVE2 B 26 | VALVE3 A 27 | VALVE4 A 28 | VALVE3 B 29 | VALVE4 B 30 | VALVE5 A 31 | VALVE6 A 32 | VALVE5 B 33 | VALVE6 B 34 | VALVE7 A 35 | VALVE8 A 36 | VALVE7 B 37 | VALVE8 B 38 | VALVE9 A (SPARE) 39 | VALVE10 A (SPARE) 40 | VALVE9 B (SPARE) 41 | VALVE10 B (SPARE) 42 | VALVE11 A (SPARE) 43 | VALVE12 A (SPARE) 44 | VALVE11 B (SPARE) 45 | VALVE12 B (SPARE) 46 | VALVE1 FDBK 47 | VALVE2 FDBK 48 | VALVE3 FDBK 49 | VALVE4 FDBK 50 | VALVE5 FDBK 51 | VALVE6 FDBK 52 | VALVE7 FDBK 53 | VALVE8 FDBK 54 | VALVE9 FDBK (SPARE) 55 | VALVE10 FDBK (SPARE) 56 | VALVE11 FDBK (SPARE) 57 | VALVE12 FDBK (SPARE) 58 | +15V 59 | SYSGND 60
P509 J509 J602 P602
RED, GRY
PERSONALITY TO DECK DISTR. CABLE ASSY C38127
TEST CONNECTOR (BACKPLANE PCB) P502
+5V 1 | SYSGND 2 | BUS A9 3 | BUS A8 4 | BUS A7 5 | BUS A6 6 | BUS A5 7 | BUS A4 8 | BUS A3 9 | BUS A2 10 | BUS A1 11 | BUS A0 12 | BUS D7 13 | BUS D6 14 | BUS D5 15 | BUS D4 16 | BUS D3 17 | BUS D2 18 | BUS D1 19 | BUS D0 20 | /BUS RD 21 | /BUS WR 22 | BUS CLK 23 | BUS RDY 24 | BUS INT 25 | NC 26 | BUS RST 27 | WATCHDOG 28 | IBM AEN 29 | IBM A9 30 | IBM BUS RDY 31 | IBM A8 32 | IBM RST 33 | NC 34
SMART CARD
PROCESSOR PCB
CR0 A0 1 | SYSGND 2 | CR0 A1 3 | SYSGND 4 | CR0 A2 5 | SYSGND 6 | CR0 A3 7 | SYSGND 8 | CR0 A4 9 | SYSGND 10 | CR0 A5 11 | SYSGND 12 | CR0 A6 13 | SYSGND 14 | CR0 A7 15 | SYSGND 16 | CR0 A8 17 | SYSGND 18 | CR0 A9 19 | SYSGND 20 | CR0 A10 21 | SYSGND 22 | CR0 A11 23 | SYSGND 24 | CR0 A12 25 | SYSGND 26 | CR0 A13 27 | SYSGND 28 | CR0 A14 29 | SYSGND 30 | CR0 A15 31 | SYSGND 32 | CR0 A16 33 | SYSGND 34 | CR0 A17 35 | SYSGND 36 | CR0 A18 37 | SYSGND 38 | CR0 A19 39 | SYSGND 40 | /CR0 SEL 41 | SYSGND 42 | /CR0 RD 43 | SYSGND 44 | CR0 REG 45 | SYSGND 46 | CR0 RST 47 | SYSGND 48 | CR0 D0 49 | SYSGND 50 | CR0 D1 51 | SYSGND 52 | CR0 D2 53 | SYSGND 54 | CR0 D3 55 | SYSGND 56 | CR0 D4 57 | SYSGND 58 | CR0 D5 59 | SYSGND 60 | CR0 D6 61 | SYSGND 62 | CR0 D7 63 | SYSGND 64 | /C01 65 | SYSGND 66 | /C02 67 | SYSGND 68 | BV01 69 | SYSGND 70 | BV02 71 | SYSGND 72 | DOOR 73 | /CR0 WR 74 | RDY/BSY 75 | SYSGND 76 | WR 77 | +5V 78 | WAIT 79 | +5V 80
P1 J1 J105 P106
RED, GRY
CPU TO SMART CARD CABLE ASSY B38131
PERSONALITY PCB
DECK DISTRIBUTION PCB
NC 1 | PUMP1 A 2 | PUMP1 B 3 | PUMP1 C 4 | PUMP2 A 5 | PUMP2 B 6 | PUMP2 C 7 | PUMP3 A 8 | PUMP3 B 9 | PUMP3 C 10 | PUMP4 A 11 | PUMP4 B 12 | PUMP4 C 13
P502 J502 J603 P602
SHIELD 1 | PUMP1 A 2 | PUMP1 B 3 | PUMP1 C 4 | PUMP2 A 5 | PUMP2 B 6 | PUMP2 C 7 | PUMP3 A 8 | PUMP3 B 9 | PUMP3 C 10 | PUMP4 A 11 | PUMP4 B 12 | PUMP4 C 13
PERSONALITY TO DECK DISTR. CABLE ASSY C38130
REAR PANEL SUBASSY #101383
TXD 1 | NC 2 | RTS 3 | NC 4 | RXD 5 | NC 6 | CTS 7 | NC 8 | GND 9 | GND 10
J P 2
+5VDC 2 | GND 1
J P 1 1
SERIAL BRIDGE PCB #101035
CABLE ASSY RS232/DPAC PCB #101015
1 – NC | 2 – NC | 3 – NC | 4 – NC | 5 | 6 – NC | 7 – NC | 8 – NC | 9 – NC | 10 – NC
RXD TO TXD-BRN
TXD TO RXD-BRN
BLK – SYSGND – EXT.
+5VDC – RED – CENT.
J P 1 1 0 1 3
1 – NC | 2 – NC | 3 | 4 – NC | 5 | 6 – NC | 7 – NC | 8 – NC | 9 | 10
PROCESSOR PCB
P303
1 CDM3 – DCD | 2 CDM3 – DSR | 3 CDM3 – RXD | 4 CDM3 – RTS | 5 CDM3 – TXD | 6 CDM3 – CTS | 7 CDM3 – DTR | 8 CDM3 – RI | 9 CDM3 – GND | 10 CDM3 – +5VDC
THIRD ANGLE PROJECTION
DASH No | MAKE FROM | PROCESS/DESCRIPTION | USED ON
MULTI–PROCESS CHART
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MATERIAL:NONE
FINISH:NONE
DRN AL EUGENIO DATE 11–3–93
CHK D.S. JANKINS DATE 1–5–94
APP'D S. JANKINS DATE 1–5–94
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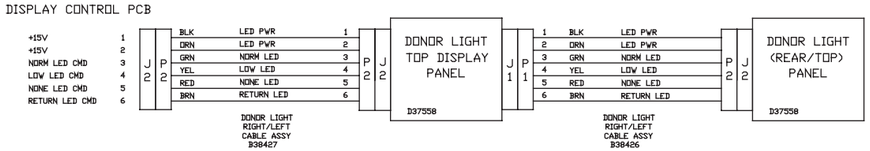
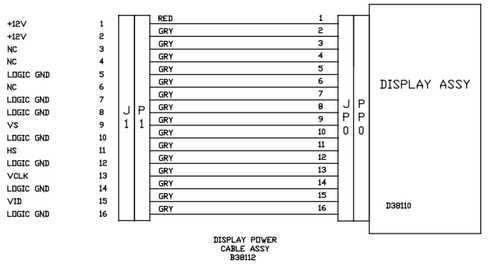
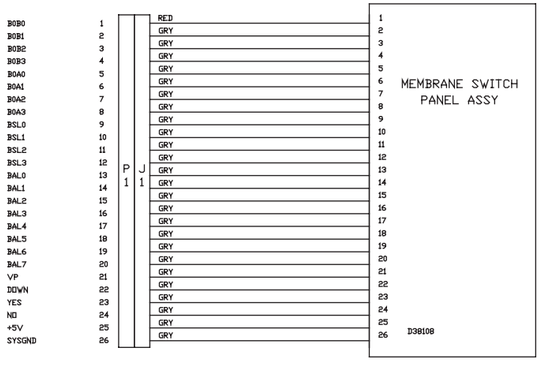
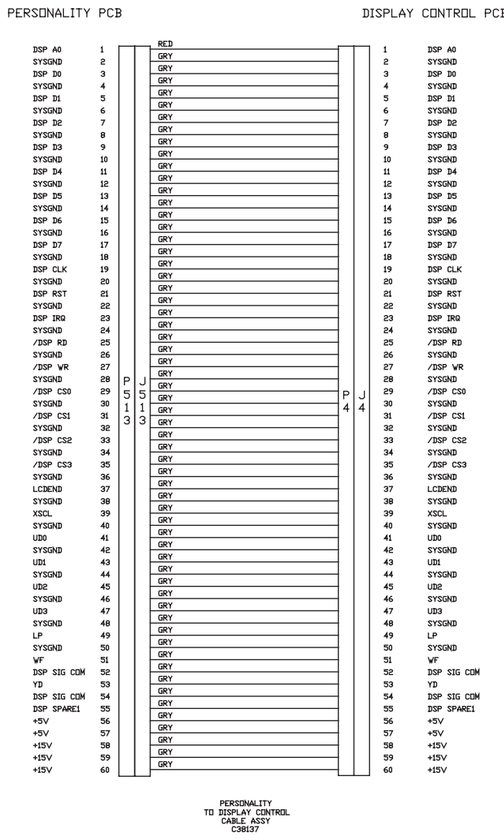
HAEMONETICS CORPORATION
400 WOOD ROAD, BRAINTREE, MASSACHUSETTS 02184
SCHEMATIC, SYSTEM, MCS+
SIZE E | 38136 | REV G
SCALE:NONE
SHEET 8 OF 9
SOP FORM 2.7.A, REV C

REVISIONS					
REV	DESCRIPTION	REVD BY	DATE	CHK/APPR	DATE
	SEE SHEET 1 FOR REVISIONS				









DASH No	MAKE FROM	PROCESS/DESCRIPTION	USED ON
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–	–	–	–

MULTI-PROCESS CHART

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TOLERANCES:
ANGULAR ±1/2°
TWO PLACE DECIMAL ±.01
THREE PLACE DECIMAL ±.005
FOUR PLACE DECIMAL ±.0025
BREAK SHARP CORNERS .01/.02R
MATERIAL: NONE
FINISH: NONE
DWN: AL EUGENIO DATE: 11-3-93
CHKD: S. JANKINS DATE: 1-5-94
APPR: S. JANKINS DATE: 1-5-94

THIRD ANGLE PROJECTION

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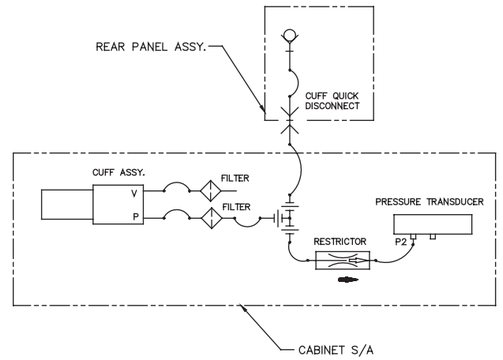
SCHEMATIC, SYSTEM, MCS+

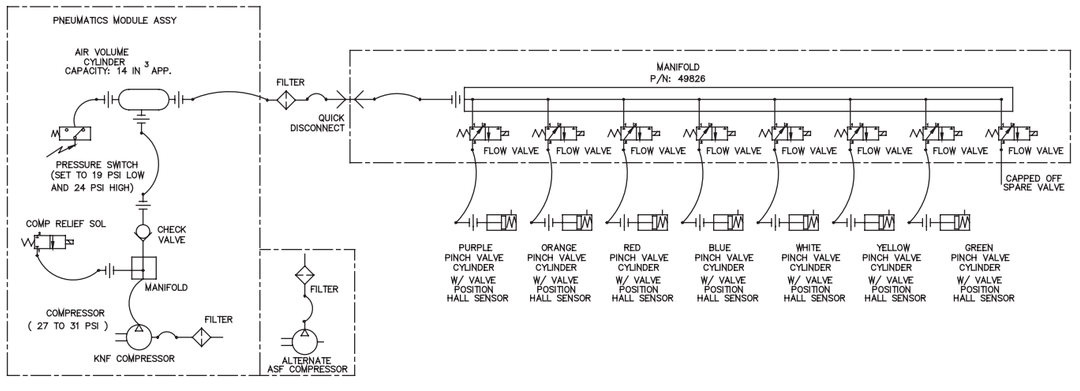
D	38136	REV.

SCALE: NONE SHEET 9 OF 9
SOP FORM 2.7.A, REV 0

REVISIONS					
REV	DESCRIPTION	REVD BY	DATE	CHK/APPR	DATE
B	REV PER ECO 20066	M.R.	9-26-95	R. PLAISTED	9-26-95
C	REV PER ECO 20412	JRL	4-10-96	R. PLAISTED	6-10-96
D	REV PER ECO 31075	TNH	9-14-01	J. ARRUDA	2-11-02

MCS + PNEUMATIC SYSTEM SCHEMATIC




PNEUMATICS MODULE ASSY
AIR VOLUME CYLINDER CAPACITY: 14 IN 3 APP.
PRESSURE SWITCH (SET TO 19 PSI LOW AND 24 PSI HIGH)
COMP RELIEF SOL
CHECK VALVE
MANIFOLD
COMPRESSOR (27 TO 31 PSI)
FILTER
KNF COMPRESSOR
FILTER
QUICK DISCONNECT
FILTER
ALTERNATE ASF COMPRESSOR
MANIFOLD P/N: 49826
FLOW VALVE
FLOW VALVE
FLOW VALVE
FLOW VALVE
FLOW VALVE
FLOW VALVE
FLOW VALVE
FLOW VALVE
CAPPED OFF SPARE VALVE
PURPLE PINCH VALVE CYLINDER W/ VALVE POSITION HALL SENSOR
ORANGE PINCH VALVE CYLINDER W/ VALVE POSITION HALL SENSOR
RED PINCH VALVE CYLINDER W/ VALVE POSITION HALL SENSOR
BLUE PINCH VALVE CYLINDER W/ VALVE POSITION HALL SENSOR
WHITE PINCH VALVE CYLINDER W/ VALVE POSITION HALL SENSOR
YELLOW PINCH VALVE CYLINDER W/ VALVE POSITION HALL SENSOR
GREEN PINCH VALVE CYLINDER W/ VALVE POSITION HALL SENSOR

SYMBOL LIBRARY	
	SOLENOID VALVE 3-WAY, N.O., SPRING RETURN (VACUUM APPLICATION)
	PRESSURE ELECTRIC SWITCH
	PNEUMATIC CYLINDER SINGLE ACTING, SPRING RETURN PISTON POSITION HALL SENSOR
	BARBED FITTING
	ACCUMULATOR
	SOLENOID VALVE 3-WAY, N.C., SPRING RETURN (PRESSURE APPLICATION)
	PNEUMATIC COMPRESSOR FIXED DISPLACEMENT
	RESTRICTOR (FIXED OUTPUT)
	QUICK DISCONNECT COUPLING
	FILTER
	FLEXIBLE LINE
	FLOW DIRECTION
	SOLENOID VALVE 2-WAY, N.C., SPRING RETURN

DASH No	MAKE FROM	PROCESS/DESCRIPTION	USED ON
		MULTI-PROCESS CHART	

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TOLERANCES:
ANGULAR ± 1/2°
TWO PLACE DECIMAL ±.01
THREE PLACE DECIMAL ±.005
FINISH SURFACES 32 RMS
BREAK SHARP CORNERS .01/.02R
MATERIAL: AS SHOWN
FINISH: NONE
DRAWN: JMH DATE 11-24-97
CHECKED: S. JANKINS DATE 1-5-94
APPROVED: S. JANKINS DATE 1-5-94

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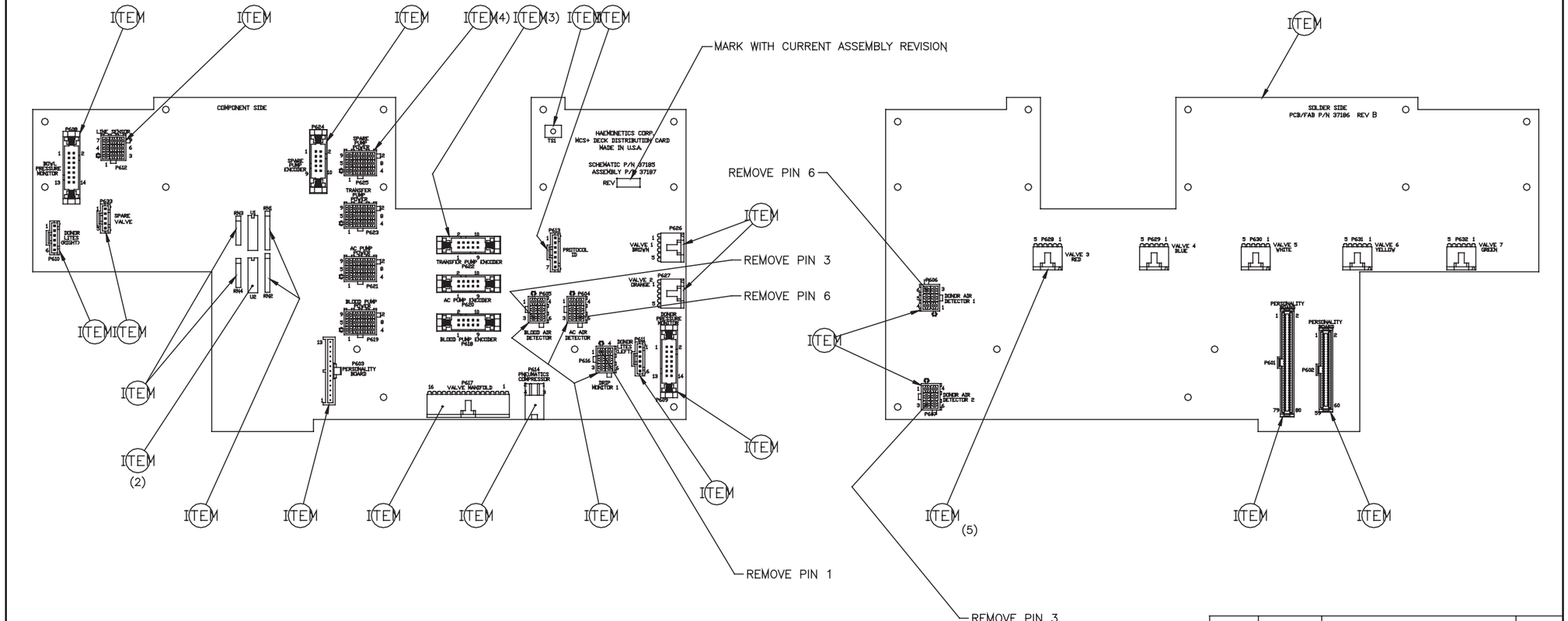
MCS+ PNEUMATIC SCHEMATIC

	38135	D

SCALE: NONE SHEET 1 OF 1

SOP FORM 2.7-A, REV A

REVISIONS					
REV	DESCRIPTION	REVD BY	DATE	CHK/APPR	DATE
A	RELEASE PER ECO 12126	JMM	11-30-93	S.J.	1/18/94
B	REV. PER ECO 20160	JRL	11/16/95	R. SYLVIA	11/16/95



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MULTI-PROCESS CHART

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UNLESS OTHERWISE SPECIFIED
TOLERANCES
ANGULAR ± 1/2°
TWO PLACE DECIMAL ±.01
THREE PLACE DECIMAL ±.005
FINISH SURFACES 125 RMS
BREAK SHARP CORNERS .01/.02R
MATERIAL: SEE B.O.M.
FINISH: ------
DRAWN: J. ROBERTS DATE 11-1-93
CHECKED: S.J. DATE 1/18/94
APPROVED: S.J. DATE 1/18/94

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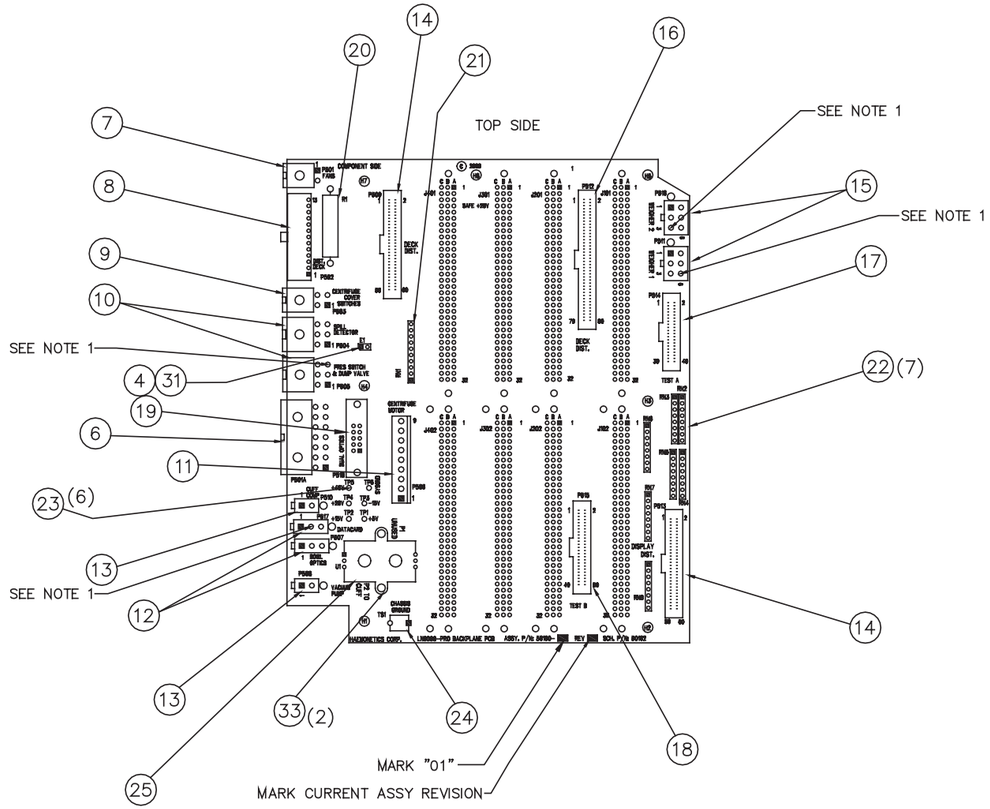
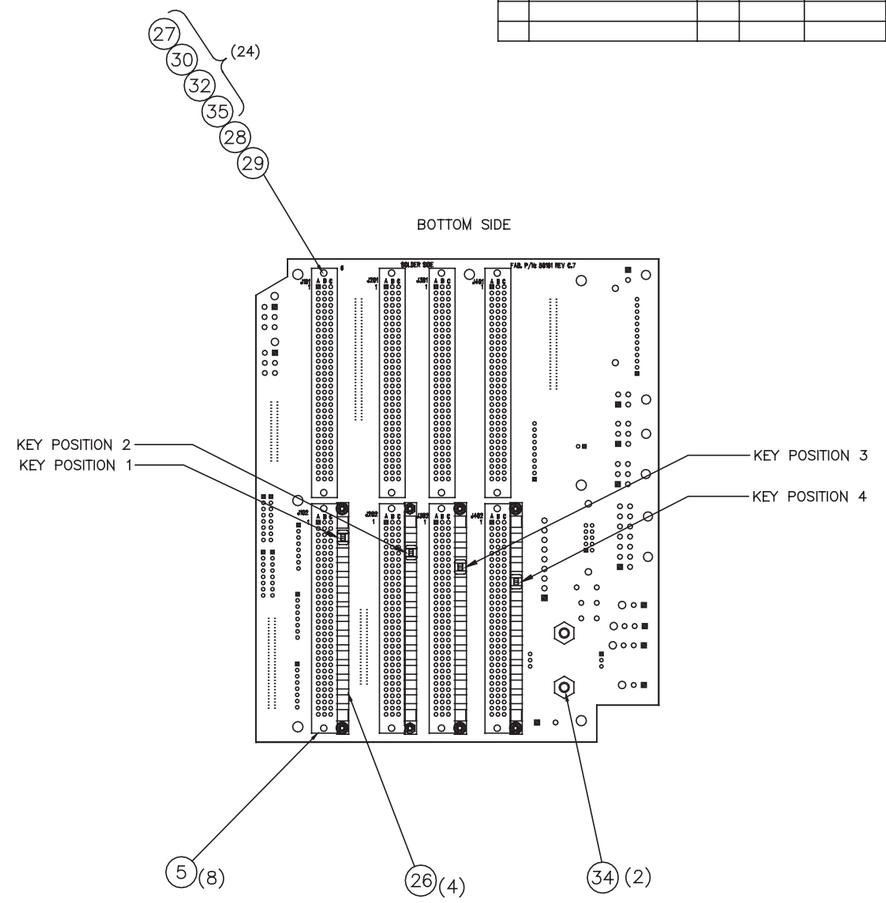
ASSEMBLY, PCB
DECK DISTRIBUTION

D | 37187 | B

SCALE: 1:1 SHEET 1 OF 1

REVISIONS					
REV	DESCRIPTION	REVD BY	DATE	CHK/APPR	DATE
D	REL PER ECO 32659	NCA	4-16-04	K. BURKE	10-13-04





NOTES:

1. REMOVE PIN FROM CONNECTORS BEFORE SOLDERING:
   P505-3, P511-6, P516-3, P517-2.
2. INSERT KEYS AS SHOWN INTO ITEM 26.
3. PC BOARD MUST BE ASSEMBLED IN COMPLIANCE WITH IPC-A-610.

DASH No	MAKE FROM	PROCESS/DESCRIPTION	USED ON

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DIMENSIONS ARE IN INCHES
TOLERANCES:
ANGULAR ±1/2°
TWO PLACE DECIMAL ±.01
THREE PLACE DECIMAL ±.005
FINISH SURFACES 63 RMS
BREAK SHARP CORNERS .01/.02R

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BACKPLANE PCB ASSY, LN9000

MATERIAL: SEE BOM
FINISH: NONE
DWN. N. ALLIE DATE 4-16-04
CHKD. N. ALLIE DATE 4-16-04
APPR. N. BARUCH DATE 4-21-04

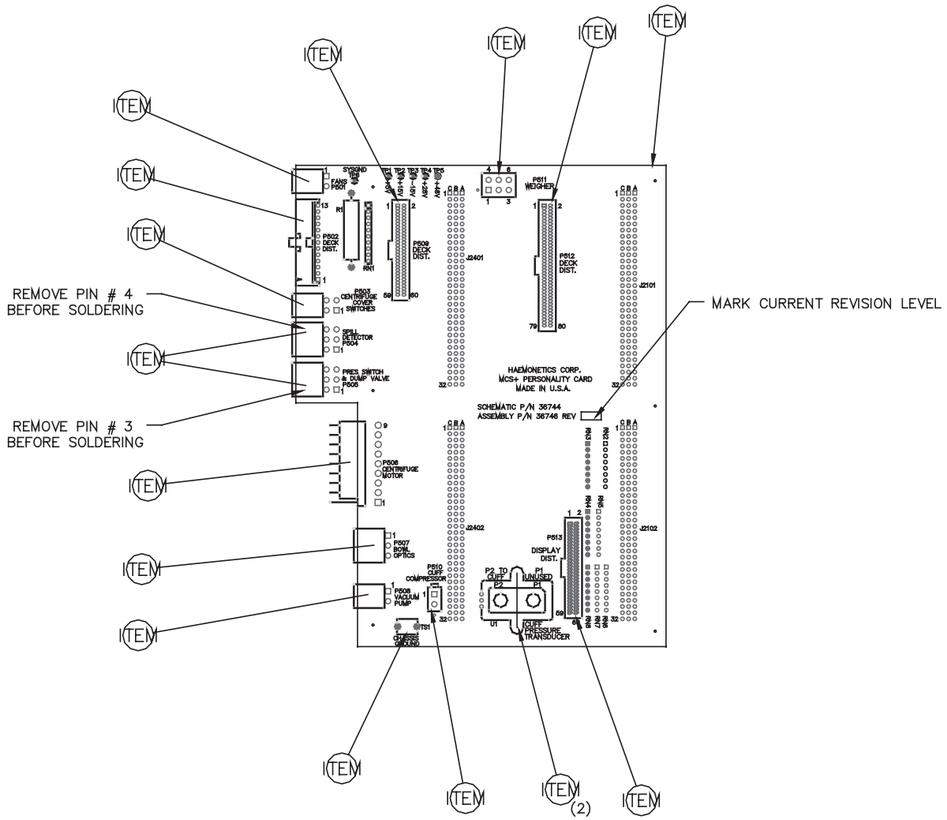
THIRD ANGLE PROJECTION

D | 50160-01 | REV D

SCALE: 1:1 SHEET 1 OF 1

SOP FORM 2.7.7, REV C

REVISIONS					
REV	DESCRIPTION	REVD BY	DATE	CHK/APPR	DATE
C	REV PER ECO 13658	J.L.	4–25–95	J. LOIBLE	4–25–95
D	REV PER DCO 14003	JRL	10–19–95	B. SHAPETON	10–20–95
E	MFG100380	MDD	12–1–05	R. LETENDRE	12–1–05



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TWO PLACE DECIMAL ±.01
THREE PLACE DECIMAL ±.005
FINISH SURFACES 63 RMS
BREAK SHARP CORNERS .01/.02R

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PERSONALITY PCB ASSY

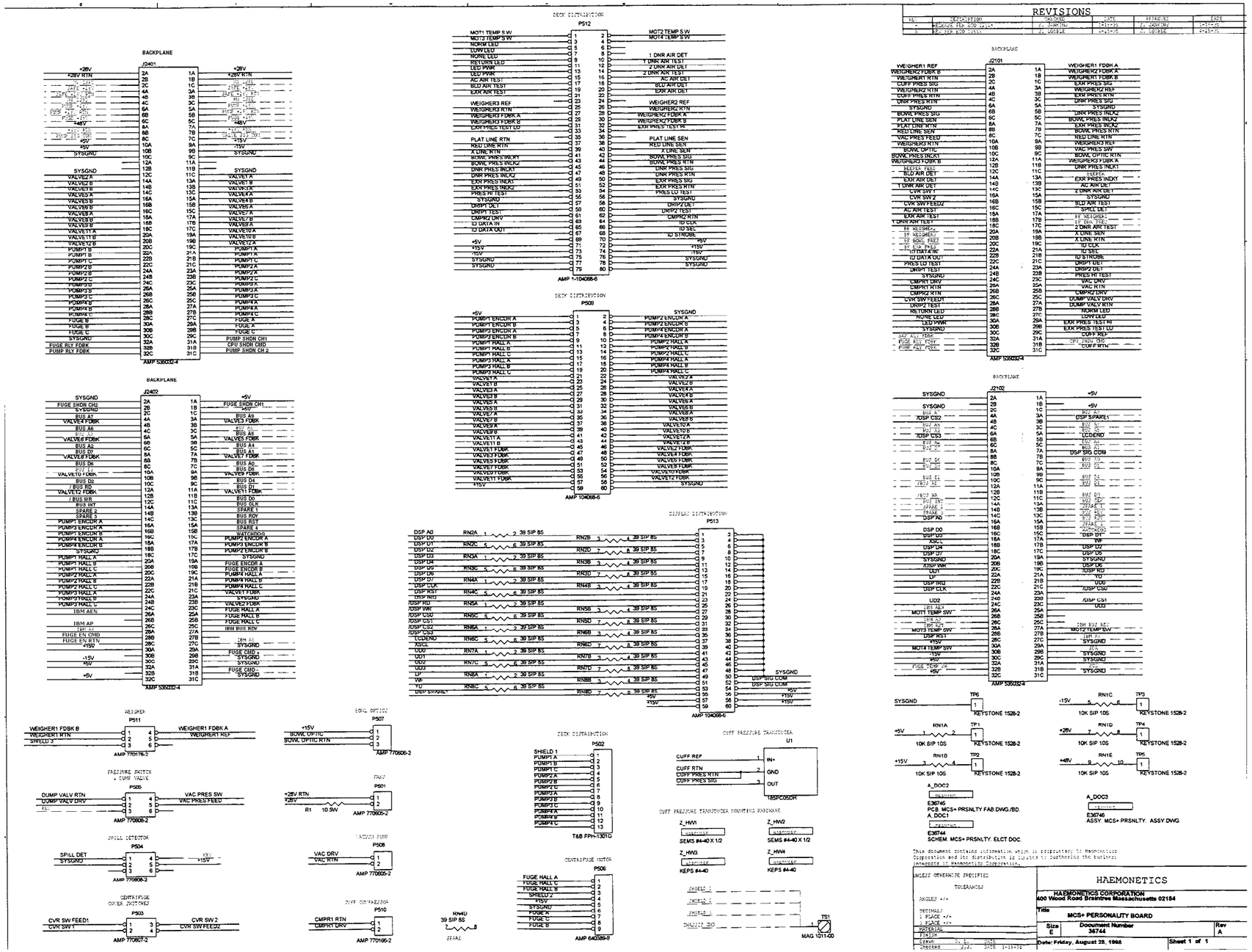
MATERIAL: SEE BOM
FINISH: NONE
DWN. *J. Buonopane Jr.* DATE 11–29–93
CHKD. S. JANKINS DATE 1–18–94
APPR. S. JANKINS DATE 1–18–94

THIRD ANGLE PROJECTION

D | 36746–00 | REV E

SCALE: FULL SHEET 1 OF 1

SOP FORM 2.7.7, REV C


REVISIONS
BACKPLANE
J2401
AMP 535032-4
BACKPLANE
J2402
AMP 535032-4
DECK DISTRIBUTION
P512
AMP 1-1040686-6
DECK DISTRIBUTION
P509
AMP 1040686-6
DISPLAY DISTRIBUTION
P513
AMP 1040686-6
BACKPLANE
J2101
AMP 535032-4
BACKPLANE
J2102
AMP 535032-4
WEIGHER
P511
AMP 770676-2
BOWL OPTIC
P507
AMP 770606-2
PRESSURE SWITCH & DUMP VALVE
P505
AMP 770606-2
TRAP
P501
R1 10 5W
AMP 770605-2
SPILL DETECTOR
P504
AMP 770606-2
VACUUM PUMP
P508
AMP 770605-2
CENTRIFUGE COVER SWITCHES
P503
AMP 770607-2
DUMP SOLENOID
P510
AMP 770705-2
RN4D
39 SIP 8S
SPARE
DECK DISTRIBUTION
P502
T&B FPH-1301G
CENTRIFUGE MOTOR
P506
AMP 640389-8
CUFF PRESSURE TRANSDUCER
U1
185PC05DH
CUFF PRESSURE TRANSDUCER MOUNTING HARDWARE
Z_HW1
SEMS #4-40 X 1/2
Z_HW2
SEMS #4-40 X 1/2
Z_HW3
KEPS #4-40
Z_HW4
KEPS #4-40
MAG 1011-00
RN1A
10K SIP 10S
RN1B
10K SIP 10S
RN1C
10K SIP 10S
RN1D
10K SIP 10S
RN1E
10K SIP 10S
KEYSTONE 1528-2
A_DOC2
E36745
PCB, MCS+ PRSNLTY FAB.DWG./BD.
A_DOC1
E36744
SCHEM. MCS+ PRSNLTY. ELCT DOC.
A_DOC3
E36746
ASSY. MCS+ PRSNLTY. ASSY.DWG.
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Rev A
Date: Friday, August 29, 1998
Sheet 1 of 1